J.R. VÁVRA-5000 YEARS OF GLASS-MAKING

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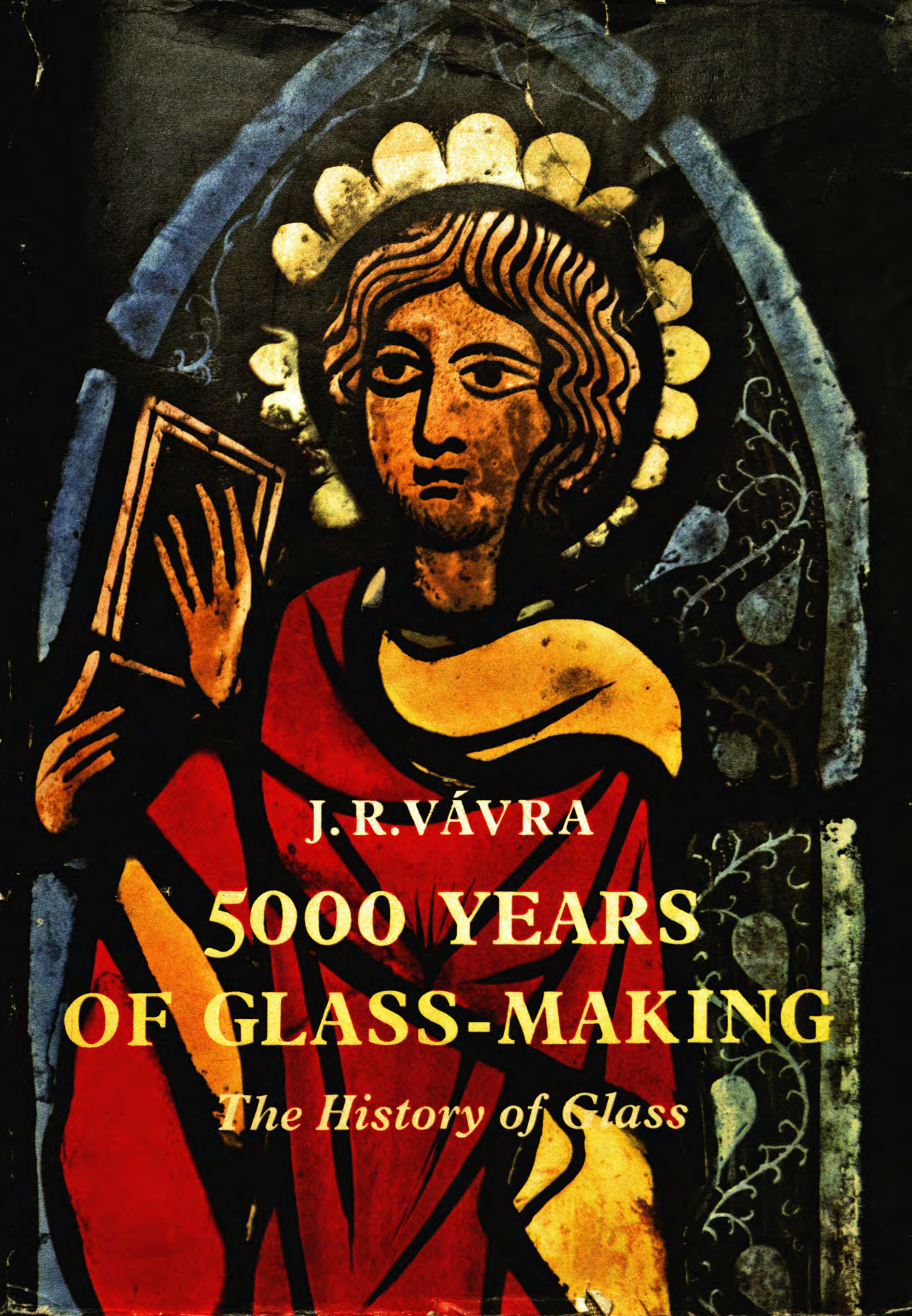

J. R. VÁVRA

5000 YEARS OF GLASS-MAKING

The History of Glass

To Uni
With all our love
Mum + Dad

25th July/77

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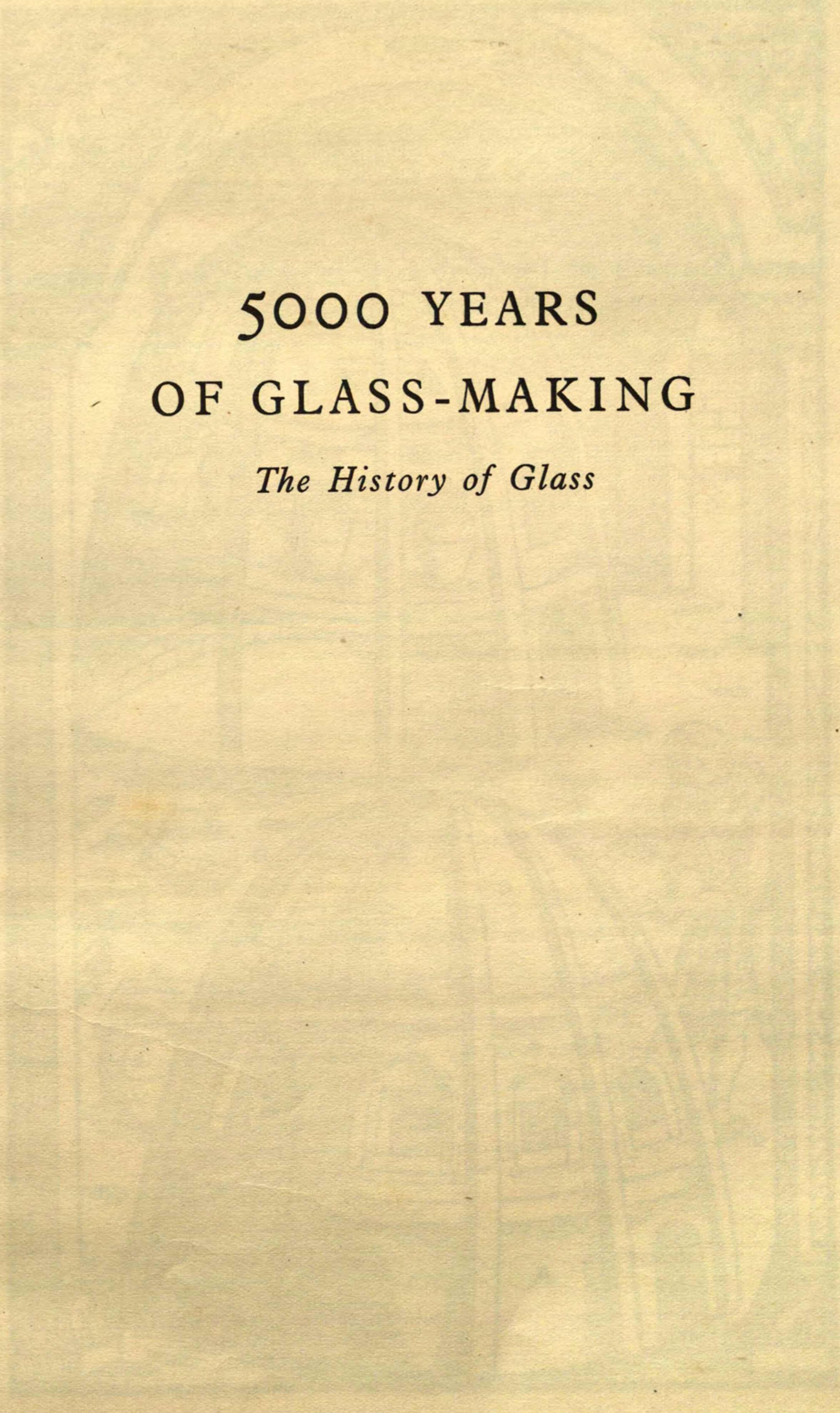
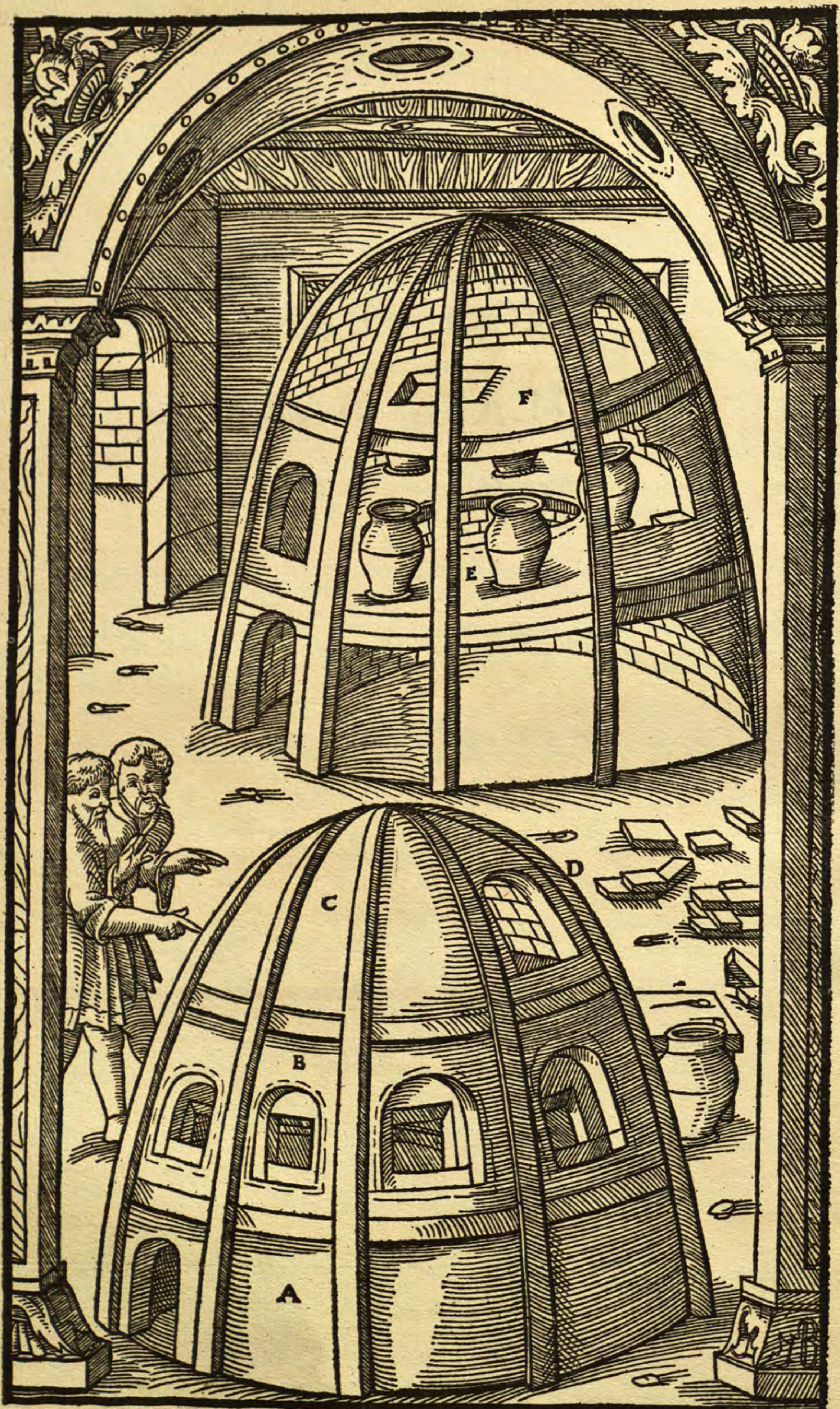


5000 YEARS OF GLASS-MAKING

The History of Glass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JAROSLAV R. VÁVRA

5000 YEARS OF GLASS-MAKING

The History of Glass

ARTIA

PRAGUE

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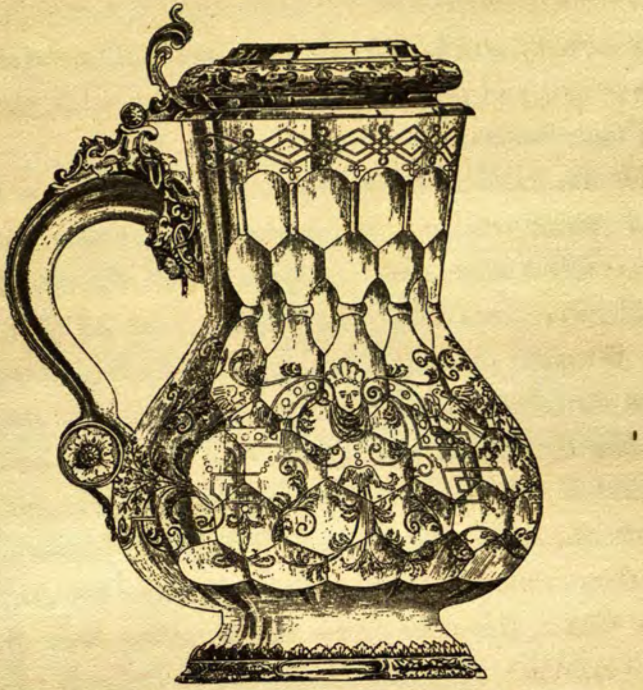


2. *Cut and engraved jug of crystal glass; 17th century, Bohemia. Reproduced from Gerspach's work.*

INTRODUCTION

"IT WAS GLASS that made Bohemia's fame in the world." Those are the words of Dr. Edmund Schebek at the beginning of his "Sources for the History of Bohemian Glass."

The world has heard of Bohemia — not from stories of attacks on other countries, nor from the history of its exploitation of other peoples — no, the world has heard of Bohemia as a country which gave birth to precious and artistic creations, to a truly national art.

For, doubtlessly, one of the fundamental characteristics of the art of glass-making is that it is a people's art; in this our people, in co-operation with the German settlers, have for centuries far exceeded all other nations. In this we outdid even those countries which at that time had at their disposal far greater means for cultural development.

After the Thirty Years' War Bohemia was wedged in among the defeated countries, and the Czech people faced the lot of an extinguished nation. As the loot of the mercenaries of an international officers' clique the country was handed over to the forces of darkest reaction. These carried out the welcome order to block up over the head of this beaten, usurped and suppressed nation the last aperture through which a stray sun ray might have found its way into this darkness. Thus they hoped to silence for all times the hated Hussites — the first to make a stand against the papal hegemony — those spiritual brothers of Comenius, whose every effort went towards banishing darkness by bringing the spark of enlightenment.

Only eight hundred thousand Czechs survived the horrors of this long war which laid waste entire districts that had been cultivated for a thousand years by diligent hands.

It was at that time that something happened there — in the seclusion of our green, wind-swept border mountains, at the foot of a slope, in a spot that was scarcely accessible in summer through the virgin thickets of the forest and in winter as a result of snow-drifts. The giant trees there were falling, one by one, and decaying, because they were not turned to any account by the Habsburg monarchy which had been weakened *by war and by its primitive economy and had become a semi-oriental, agrarian state. It was here amid the meager fields where only poor oats and flax grew that those men lived in poverty and toil, whose destiny it was to carry the name of their homeland far into the world.*

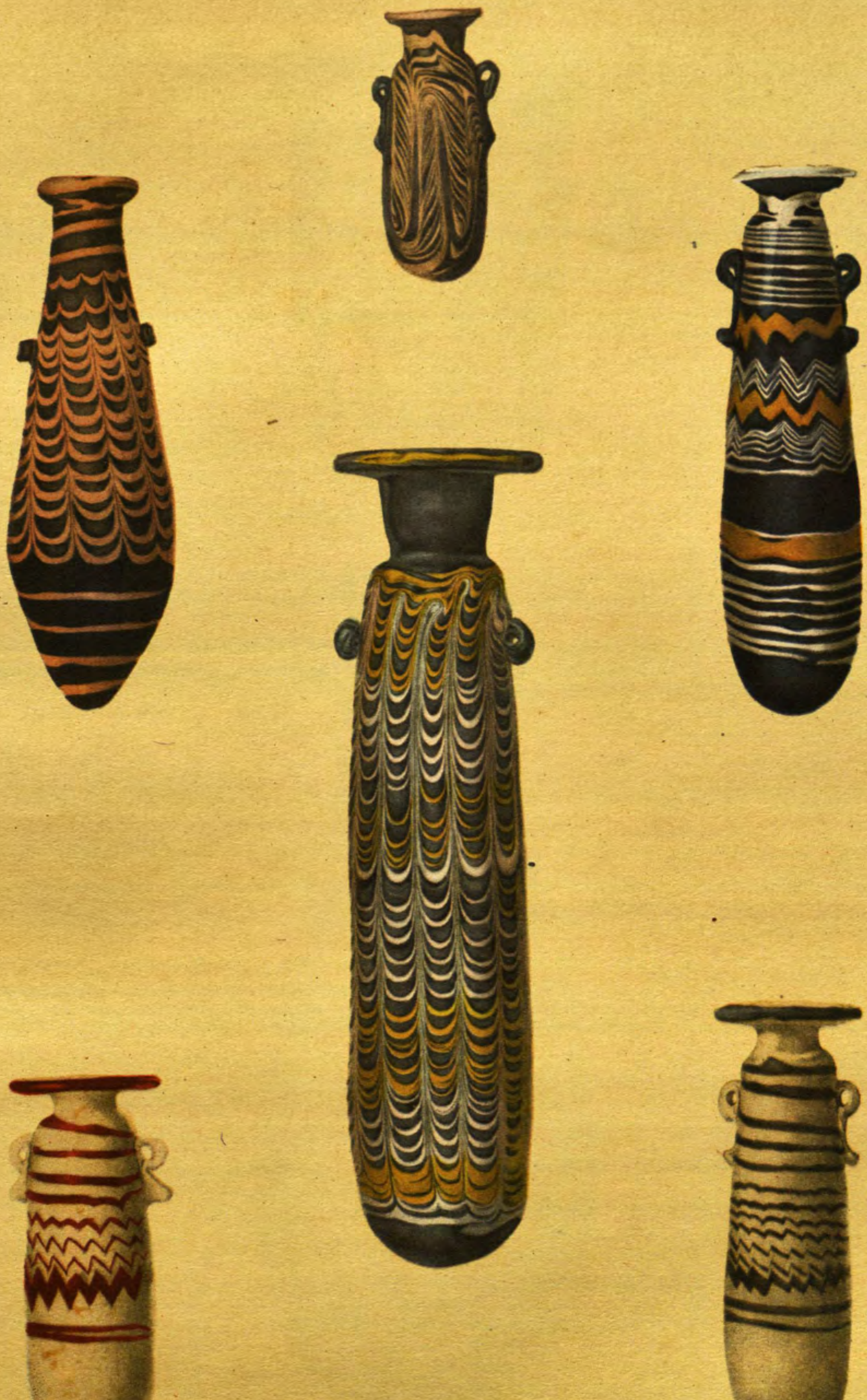
Together with settlers from the neighbouring countries the people countered their terrible fate by infusing all their artistic feeling and inventiveness into one incomparable creation. Eager hands shaped that hard and clear matter — glass — which alone dared to compete with the transparent rock-crystal. Cut like precious stones, in manifold curves, into which the people poured all their sorrow and thoughtfulness, this glass left the country. Wrapped in straw, on carts, wickerbaskets, over uneven cart-tracks, narrow paths and bad field-lanes, on scarcely navigable rivers, the Bohemian glass started its endless journey to all the cities of Europe. On reaching the farthest harbours, it set out to circle the earth in the hold of old-fashioned sailing-ships, to conquer the world that for whole centuries paid homage to this glass.

Simple glass-blowers, works assistants, cutters, engravers and glass-painters offered their glass in London and Paris, in Moscow and Constantinople. Bohemia had no harbour like Alexandria, Sidon, Byzantium, Venice, Antwerp, Genoa or Cadiz. But these people had something more than other nations: they were forced to fight for their bare existence. That was the reason why Bohemia was the first European country to rebel against the feudal order, and even at times of deepest humiliation the people were unwilling to relinquish their will to live. Their skilful, tireless hands helped them to find a way out this desperate situation.

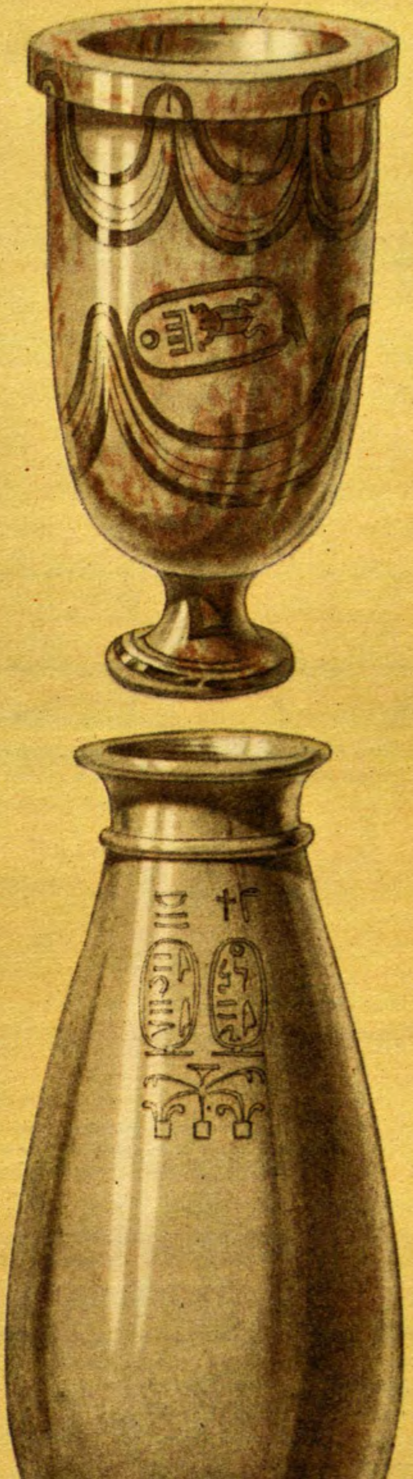
In Bohemia the art of glass-making goes back to the original Celtic inhabitants whose glass ornaments lie buried deep in valleys and forests. The numerous enemies in their attacks many repeated times burnt the thatch-roofs of the glass-houses and the documents that described the production process — but they could not deprive the people of their skill, ability, knowledge and their artistic sense any more than they could take away the ideal raw material in the earth. For in the course of many thousands of years the virgin forests of the border mountains had been turned into potash. The proceeds which the glass-makers brought home to their remote villages for their works of art increased trade, and for a time it brought a better life to the entire monarchy. The experiences and skill of our glass-exporters enabled them to raise the Bohemian industry far above the general level of Austria-Hungary.

It has been my good fortune to speak to old men who in their youth worked in the last of those memorable forest glass-houses in which the Bohemian crystal was melted in skilfully constructed clay furnaces over a fire of beech wood. This followed an ancient method whose origin we must seek perhaps in old Egypt or Assyria. These old people were unable to grasp the changes that have taken place in the last decades which tore them out of the vanishing feudal order and threw them into the speed production of imperialist capitalism. What an immense contrast: Age-old manufacture has become the scene for the super-profits of share-holders, the battlefield of the proletariat!

The economy of the nobleman with its carefully hidden exploitation became a whip that — senselessly and noisily — demanded from the glass-makers no longer works of art, but goods and more goods, whose quality was determined merely by competition and the inconsiderate chase after profits. The upheavals of economic crises forced tens of thousands of glass-makers into unemployment — sometimes for months and even years. World-famous masters in the art of glass-making hungered and had to work on road repairs as relief work for alms which hardly compared with the rewards given to Roman slaves. No wonder that those old men could not grasp technical progress nor the new methods of work and wrongly saw in them the cause for their exploitation and dethronement. To quote just one example: those old people's artists, usually gifted with an extraordinary common sense, opposed also the modern glass troughs which pour the molten liquid ceaselessly into the tireless claws of an iron giant which spits out, day and night, thousands and thousands of square yards of sheet-glass, pyramids of glass-bricks and myriads of standardized bottles.



COLOUR PLATE I



COLOUR PLATE II

What immensity of things man can produce from glass today! What a manifold contribution glass has made to the progress of civilisation in this twentieth century of electricity and — glass!

And yet, in their way, the doubters were right — those who embody the experiences of fifty centuries during which mankind fought untiringly — without scientific knowledge, sometimes successfully, sometimes in vain — for this wonderful material which was first melted by the volcanoes of our earth and before them, perhaps, by the stars of heaven.

Those old masters felt correctly that is was not "in their world" that technical glass and tableware originated without which today neither traffic nor science, neither workshop nor living room are conceivable; all this bears but a common name with those articles which continue to come forth from the glowing oval furnaces, the cutter's table, the engraving board, the workshops of painters and gilders, those noble works of art which they shape with their hands.

For artistic glass has not lost its original mission, just as the masterworks of cinematography have not displaced the painter's canvas, nor film and radio the theatre. Technique and art, or expressed differently, civilization and culture, are the red threads which, each in its own way, mark the path of humanity.

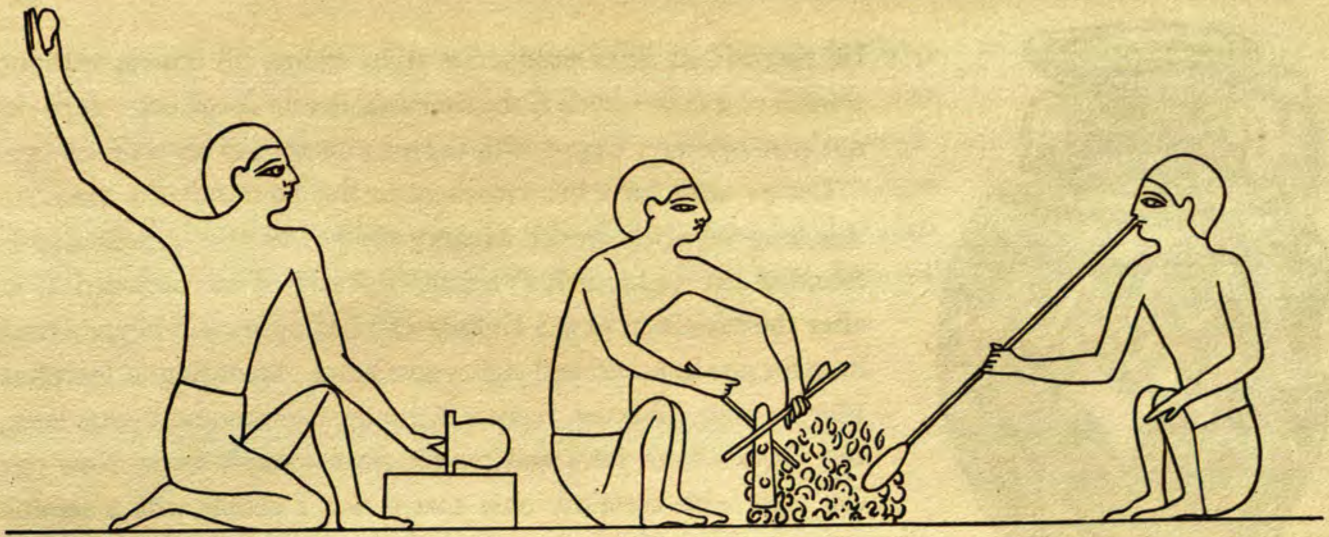
Today we stand at the cross-road of this path. It behoves us who have been able to throw off man's heaviest burden — the exploitation of man by man — to look back at the achievements of our ancestors in order, gaily and proudly, to protect the heritage of our free people — gained under such difficult conditions — and to develop it further. Our book represents such a review at a time when we are advancing to new achievements. It is not a vademecum for collectors, nor does it contain instructions for a rapid evaluation of antiquities. It is a book that explains the principles of glass-making on the basis of the changes in the methods of production.

By introducing us to this complicated and artistic craft it teaches us to love and honour the glass-workers; without this it would be a sacrilege to love glass.

JAROSLAV R. VÁVRA

I

ANTIQUITY



3. Old Egyptian smiths working at the fire. — Relief on a tomb at Beni Hassan. Reproduced from Déville's work.

ANTIQUITY LOOKS DOWN ON US FROM THE PYRAMIDS

Pallas Athene did not rise from the head of Zeus in a shining armour . . .

THE FERTILE PLAINS of the Sahara where men had been living in scattered groups were abandoned by them as the desert spread. The people fled to the life-giving river — and so Egypt grew up on the banks of the Nile. Here they learnt one main thing, after having lost the battle against Nature in all its changing aspects: they learnt to use the regular inundations of the river. That is the basic reason why, after thousands of years of terrible toil by which dams were erected to bar the water and regulate its flow over terraces and through artificial lakes, a human society arose which was based on slavery. It had already clearly defined class differences and — as Elie Faure says: "it represents the first crest of those waves which formed cultures on the surface of history." It is a fact that old Egypt could never have arisen without the art of calculating the path of time, without hieroglyphs, astronomy and land surveying and without its immensely strict social organization.

Egypt is the classical example of the uneven development of the world. While the Egyptian people emerged from the dark into history, everywhere else mankind led a life under the most primitive conditions — living mainly still in large groups, tribes, and by the power of their fists, apart, perhaps, from the countries bordering the Euphrates and Tigris, the Indus and Hoangho, where we soon witness a repetition of Egypt which, however, remained clearly in the van. Over a gap of five and a half thousand years the Egypt of that time seems to us quite perfect. Where else are we to find the cradle of human work, if not there? And if we wish to discover the beginnings of glass-making we also must turn to old Egypt.

The Eye of Pharaoh Amenhotep I.

Towards the end of the nineteenth century the famous Egyptologist Sir W. M. Flinders-Petrie found the oldest piece of glass made by human hands in Egypt: an artificial eye imitating turquoise and distinctly bearing the name of Pharaoh Amenhotep I, who reigned about the middle of the sixteenth century B. C. Sir Flinders-Petrie labelled this discovery the very first beginnings of glass-making.

4. *Egyptian glass amphora from the time of the 18th dynasty. Reproduced from A. Kisa's work, vol. I.*

He singled out glass production from among all others, without considering that — even if the time calculation is correct — it could not possibly have begun with the manufacture of an artificial eye.

Let us tarry for a brief moment in this connection to visualize this long-vanished world. History teaches us that Amenhotep I. founded the eighteenth (Theban) dynasty. That occurred soon after the expulsion of the Hyksos who had oppressed Egypt's freedom for one hundred and eighty-five years. According to Josephus Flavius, who, however, reports this some two thousand years later, the Hyksos were Jews and people from today's Syria. Now one can state with certainty only that it was a people with a semitic tongue who, taking advantage of the uprisings of peasants and slaves, came from somewhere in Asia Minor to the Nile. This is revealed in a papyrus preserved to this day:

"The King's residence was suddenly occupied; the King himself was taken prisoner by the rebels, his retinue driven from the Court; officials were killed, documents were confiscated."

A. V. Mishulin describes this insurrection as follows: "All tax records were destroyed, taxes were abolished, and the King's judges were expelled. The rebels looted the grain reserves. The mutiny spread all over the country; dams were destroyed; canals were left to silt up and the fields suffered drought." — "The waters dried up, vanished over the dams; there were more banks than water," the papyrus runs. "Many rich citizens were murdered; some fled to neighbouring countries. The King was dethroned; but the rebels could not maintain the sceptre in their hands because they did not know how to create a new social order. Their victory was but short-lived."

The Hyksos appeared in the Nile with war charriots and with Asiatic cavalry — on horseback, something the Egyptians saw for the first time. Since that country was not to know even the camel for another fifteen hundred years, the appearance of horsemen in itself meant defeat and subjugation. But finally the Hyksos were driven away and pursued as far as their original homeland. It was at that point that the previously isolationist Egyptian "Foreign Office" took up a policy of expansion with all its accompanying symptoms:

The Theban monarchs were seized with an urge for war expeditions which soon turned into a terrible power of conquest. This could not be opposed by any country in Asia Minor, which stood on a still much lower level of production and social organization. Egypt set out to enslave other states. The hereditary aristocracy collapsed before the invaders, probably even collaborated. They were replaced by a system of civil servants. And also the third class — the priests — who hitherto had not played so outstanding a role — began to produce: namely theology. The old places of religious cults appear insignificant compared with those gigantic complex places of worship that arose now. Cultural centres were established, later on also political centres, to which the victorious generals brought the immense loot they gathered on their raids to Asia Minor.

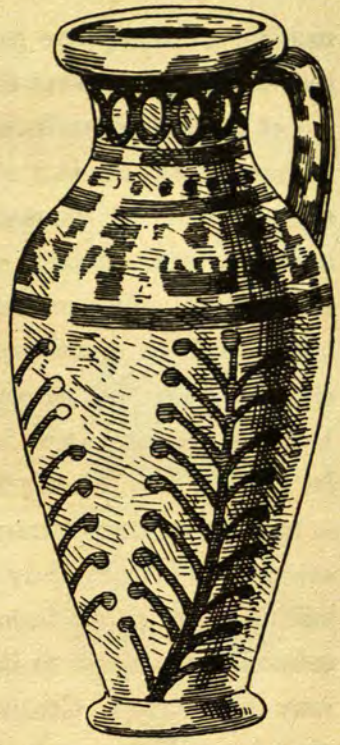
And it was this amassing of hitherto unaccustomed riches that turned an already old invention into an art: for the so-called *vase period* of Egypt presupposed almost unlimited means.

That, in rough outline, is the state of the world in which glass made its official entry. Since even now we know nothing about the melters and other workers in the Egyptian glass-houses before 1 500 B. C., it does not seem out of place to refer to those far-reaching changes in the old social order of the Hamitic people.

It must be clear that we are not dealing with the first beginnings here. For at that time a glass bead which was recently found in a layer of Unetic culture found its way into today's Bohemia. This bead must have originated during an incomparably earlier production process.

A Glass Bead, 5 500 Years Old

Undoubtedly the oldest piece of glass can be found in the Egyptian Department of the Berlin Museum. (That is to say, it was there before the Second World War.) The afore-mentioned Flinders-Petrie presented it to astonished mankind in his book "The Royal Tombs of the Earliest Dynasties" on table XXXVIII as numbers 53 and 57. This small lump of glass is a green bead, 9×5 5 mm in size, found among other articles in a tomb at Thebes. For a long time scientists regarded it as a piece of quartz that had been shaped by chance. For them it seemed incomprehensible that the art of glass-making could go back so far in history. Even the person who had found it shared this opinion. It was only when modern investigators found a hardly noticible chip that an opportunity for chemical research was offered. Rathgen tested the bead with iodeosine, and the matter turned red. This convinced doubters that here they really were dealing with glass, since quartz could not possibly have shown any colour reaction. By pulverization and analysis with ammonium-fluoride and sulfuric acid they further ascertained that the bead contained, apart from silicic acid, also calcium and sodium: it was clearly manufactured from lime and soda by human hands.


5. Glass vase, property of Pharaoh Thutmosis III. Reproduced from A. Kisa's work, vol. I.

It is today impossible to ascertain whether the production of the bead was intentional. It may well have been accidentally made during the glazing of bricks, ceramics or jewelry.

The scientific analysis of the oldest piece of glass that has hitherto been found has proved beyond all doubt that the Egyptians possessed excellent technical knowledge already three thousand five hundred years B. C. Not only did they know how to heat quartz to melting point, but also that the silicic acid contained in stones could be glazed by addition of salt or soda, and they were able to give this material any shape they desired. Professor Dr. Springer as well as H. C. Beck maintain that the art of glass-melting began in Egypt four thousand years before Christ. It was followed only a little later by Mesopotamian glass — the oldest dated find of which (at Ninive) dates back to the year 2 900 B. C. The beads dug up under the foundations of the temple tower in Assur were — as it is clear today — found in a layer which can be safely labelled ancient. Here also amber beads were found.

The Egyptian potter . . .

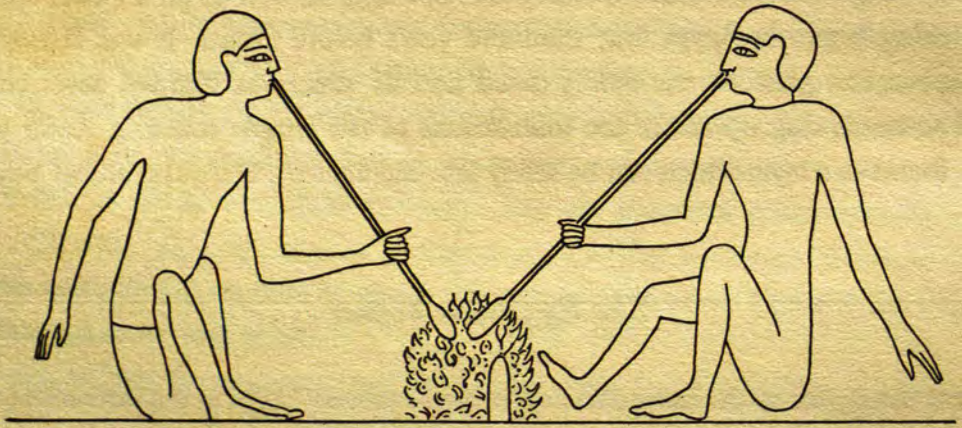
Thus we meet the potter in the semi-darkness of pre-dynastic Egypt as the initiator of the art of glass-making; it was the potter who improved his roughly kneaded, and imperfectly turned, porous articles by dipping them into a glaze. This advance was certainly unintentional; it arose merely from the craftsman's urge to improve his articles by this trick. Such "improvements" existed in every craft, and in glass-making they were frequently of decisive significance.

Let us picture this lucky accident: the clay, which that pre-historic "inventor" placed on his wheel, perhaps came, for lack of better, from the banks of an inland lake, that contained salts or potash, such as there are thousands along the North African coast. Perhaps it contained also quartz sands as well as soda, perhaps even lime and potash salt which form a high percentage in those lakes. Such raw material, when melted in the fire, became unintentionally and accidentally — glass.

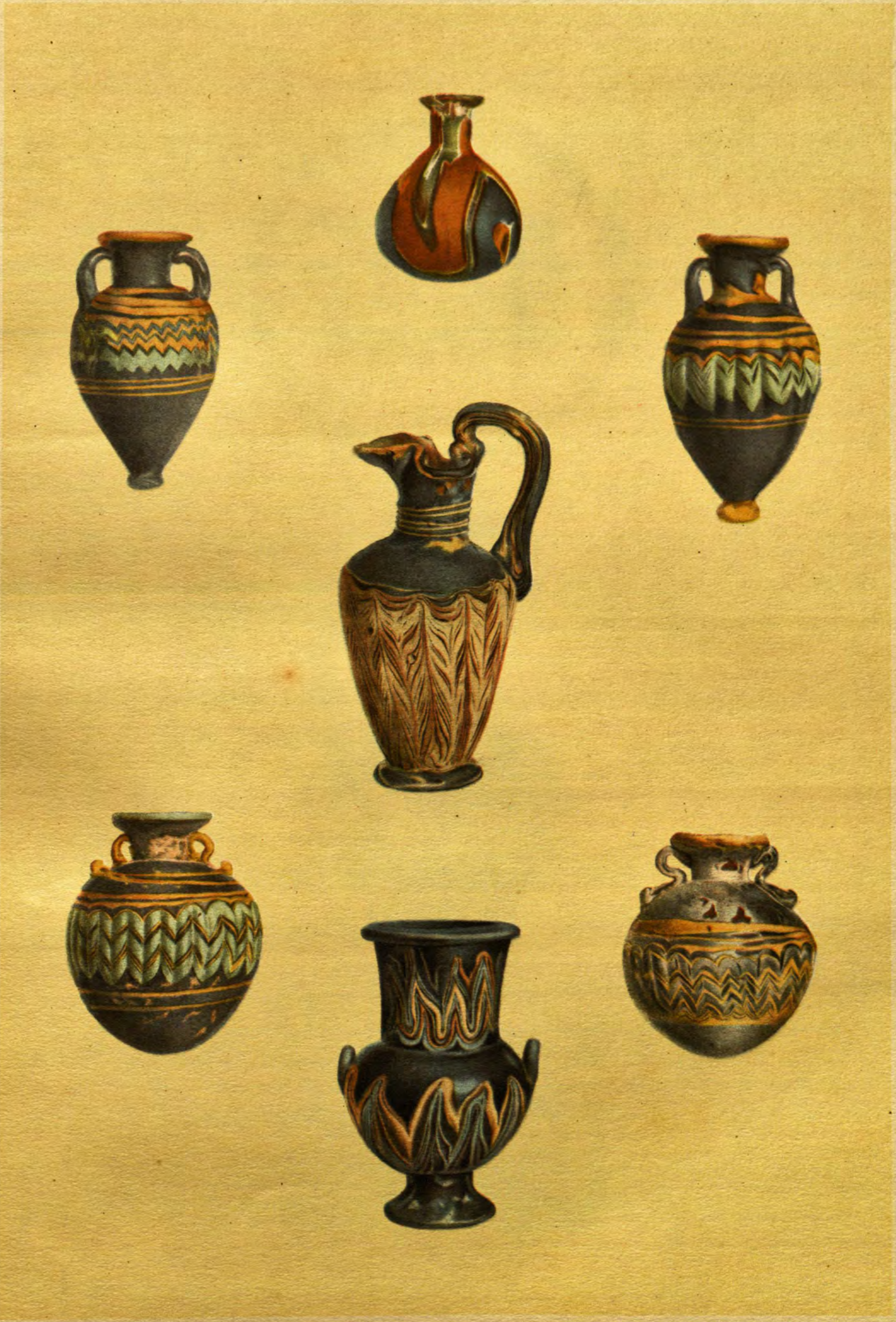
It should be mentioned that the Capsian culture was a sea culture which preceded the Egyptian civilisation. And if one realizes that Herodot's Tritons as well as their Egyptian brothers were originally Lybians, the connection is clear without resort to Pliny's "Natural History." In all probability we can lay the first stimulus to glass-making at the shores of the great North African soda and potash lakes.

In the pre-historic burial grounds in the Sahàra jewelry has been found which was made of hard, smooth stone, apparently covered with a glaze. These stones of agate, chalcedony, jasper, sardonix and jade appeared in the form of beads or small cylinders cleft in the middle. Next to them imitations of coloured glass came to light which was so hard that quartz could be scratched with it. Such finds were made deep in Central Africa which has always been inhabited exclusively by Negroes. The latter considered them extremely valuable and preserved them as part of the old, inherited family jewelry. Delafosse discovered that these decorative objects resembled in form, colour and material the jewels which the Egyptians gave their mummies on their journey after death. In the sixteenth and seventeenth century A. D. there was a lively trade in them among the English and Dutch seafarers under the designation of "pierres d'aigris — eggry heads" Similar decorations were also found on the corpses in the Assyrian and Phoenician graves, even in the North of Europe and Eastern Asia, which proves they cannot have been Egyptian products.

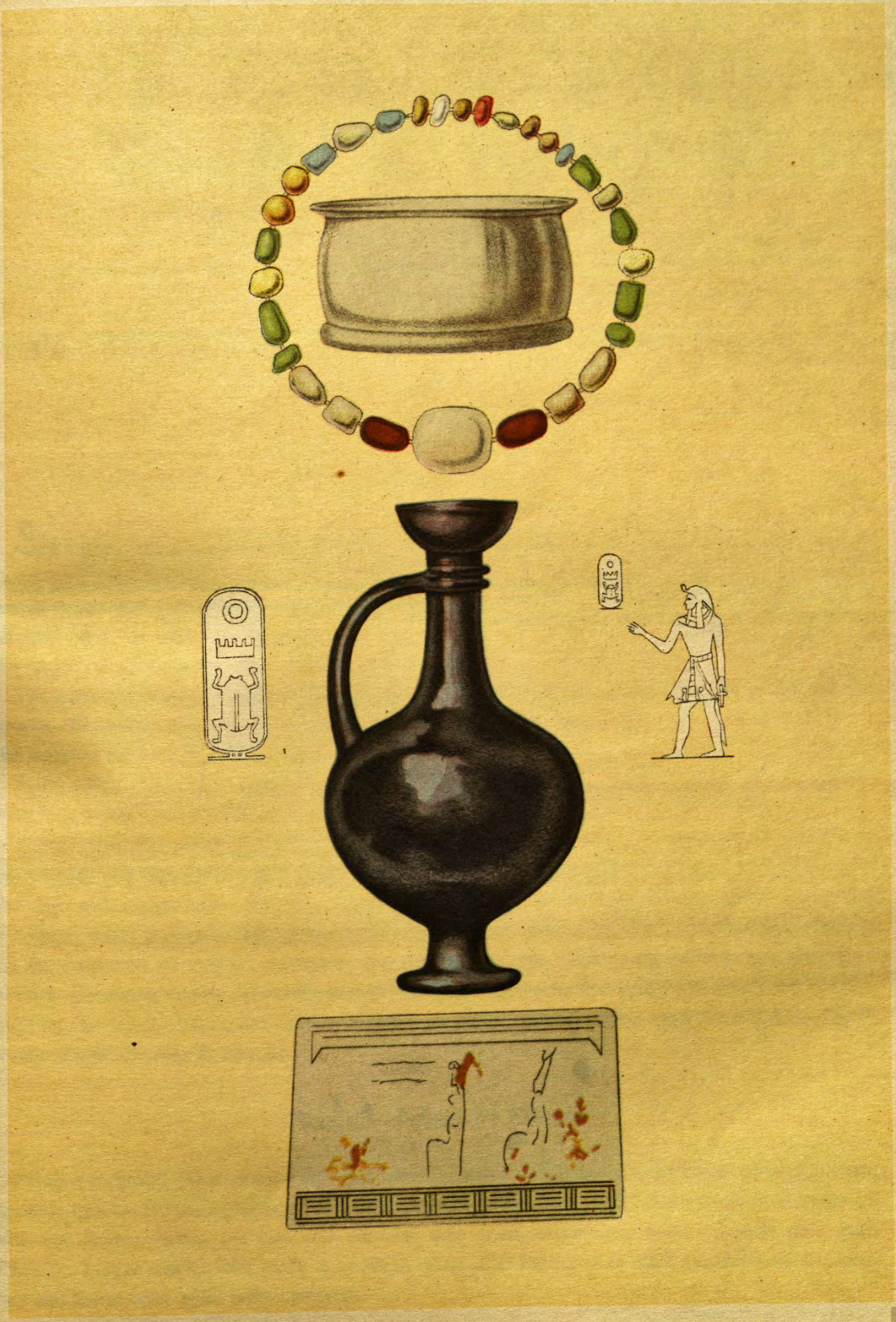
The production of luxury glass seems to have originated in Africa in times immemorial, perhaps even in the neolithic period. Frobenius wrote that on the lower course of the Nile in Illifé he had discovered an ancient workshop which might have produced those famous beads. This assumption does not contradict Delafosse's view, for Frobenius himself is convinced that this art was transplanted there from the more northerly sea border. The production must have originated at a time when the Sahara was still cultivated, for since it turned a desert the remnants of the local population have been engaged in a desperate struggle for bare existence which deprived them of all sense for art and decoration.



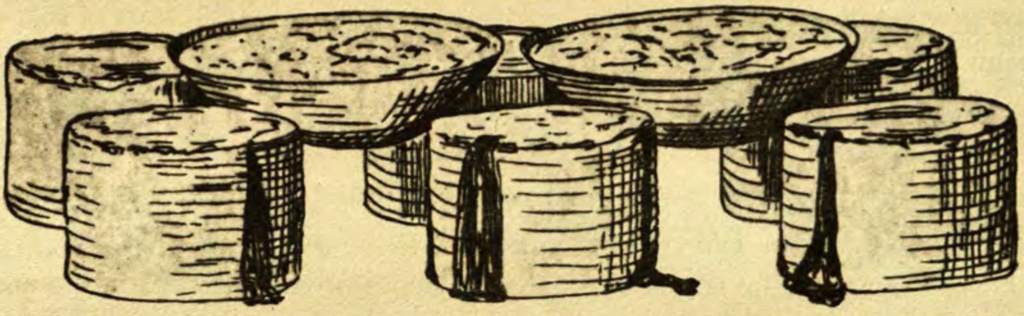
6. Relief of old Egyptian smiths on a tomb from the time of Pharaoh Usertesen I. Relief on a tomb at Beni Hassan. Reproduced from Déville's work.



COLOUR PLATE III



COLOUR PLATE IV



7. Placing of the frit pots in an old Egyptian glass furnace at Tell-el-Amarna.

THE OLDEST GLASS-HOUSES AND THE TECHNIQUES OF GLASS-MAKING

Ancient Glazes

SIR FLINDERS-PETRIE in his work on "The Arts and Crafts of Ancient Egypt" maintains that glazes on quartz and terracotta belong also to the same early period. We know pre-historic Egyptian amulets whose quartz core was covered with a coat of blue-green glaze. It is interesting that the glaze, though chipped off in the course of time, can still be recognised today since it partially affected the surface of the quartz. Such a glazed stone resembles marble, or one might rather say, a piece of candy sugar.

The glazing of terracotta objects (green and blue corals) can equally be traced back to pre-historic epochs. We have in our possession fragments of a vase from the year 3 300 B. C. Its green glaze carried the name of the first Egyptian pharaoh MENNY.

Petrie writes: "And it is surprising that the royal name was added in a second colour which may have been violet once, but which — today — is completely faded."

At that time they glazed not only artistic objects, but also used glazes to cover entire walls. Thirty centimetres long tiles have been found with perforated ribs at the back, by which they were attached to the walls with copper wire. They are completely covered with a hard, greeny-blue glaze. Their front is covered with a pattern of interwoven reeds — in imitation of what usually formed the wall covering. On the fragments we can see colourfully designed hieroglyphs. This points to the use of decorative writing. The oldest visiting card originated also from the time of the first dynasty: A glazed piece of clay showing the relief portrait and titles of a native chief. In memory of his visit this had been placed in the temple treasury at Abydos.

The Tell-el-Amarna Furnace

From a technical point of view this and later Egyptian glazed goods were kneaded out of porous, crumbly quartz-clay paste (perhaps Nile mud). Sometimes this was so soft that it could be scraped off with the fingers. When the clay was moulded and dried, decorations were engraved on it with a needle. Larger articles were made in sections, which after baking were stuck together with the same clay and baked once again before glazing.

The colours were green and blue since they could be achieved by a combination of copper. The blue they used seems to have been almost without iron; else a greenish hue could not have been avoided. Beck believes that the difference between the old Egyptian glass (glaze) and majolica can be expressed as follows: "Normal glass contained 6—10% lime, 15—20% soda and the rest quartz sand which in majolica formed 94—99%, whereas it contained only 2% lime and, at the most, 1% soda."

The half-burnt pots found in Tell-el-Amarna reveal to us the working methods.

The floor of the baking furnace consisted of flints. When these had been heated a number of times they burst and became grit which then was mixed with potash, lime, soda and copper carbonate, and was roasted as" frit" in the pots. The exact shades of colour depended on the degree of heating. The substance then partially melted into a dough. Then it was kneaded and alternatively heated, whereby the colour changed gradually until it reached the desired hue. In this way a mass of glass of uniform colour arose, which was then pounded in water and tempered to blue or green. Together with a solvent this material was put into the potter's kiln as glaze or was mixed with loam or white-of-egg to serve as colouring for fresco painting. In this way Petrie explains the process.

Vessels of Glass-Fibres

In practice Egyptian glass manufacture must have begun in this manner. It is a controversial question whether the same can be asserted of Mesopotamia where the cultural epoch of glazed articles — so astonishingly similar to glass production at that time — may have preceded it or existed simultaneously. But the purists refuse to admit even what they have been unable to disprove: e. g. the Sargon Vase from the eighth century before Christ. Thus Bruno Meissner in his work "Babylon and Assyria", part I, p. 235 and 272 (1920), who, of course, could not have known about the discovery of the tablet library (described elsewhere in this book).

The glass-blower's pipe is of much later origin. All Egyptian vessels were created without it, as will be shown, by the art of glass moulding. Until the year 30 B. C. the Egyptian glass-maker worked the glass not in its liquid state, but in its viscous, usually as 3 mm thick fibres. The production of hollow glass is therefore basically different from the later period and shows the old Egyptian society holding to tradition in spite of all reforms and continuing unchanged up to the ascension of the Ptolemies. Let us now look at a glass-house from the time of Amenhotep IV (approx. 1370 B. C.), the remnants of which were uncovered and described by Petrie.

The glass used by the Egyptians at that time was pure; that is, not colourless, but of a shade that could be given a great variety of hues. It contained neither lead nor bromine and consisted of pure quartzite, ground flints and alkali derived from wood ash. This mixture was melted in clay pots, in earlier periods apparently in pits, later in furnaces. Non-transparent colours were added which were thoroughly known already to glass-makers at that time.

8. Old Egyptian glass balsamarium. 18th dynasty, about 1500 B. C. Reproduced from A. Kisa's work, vol. I.

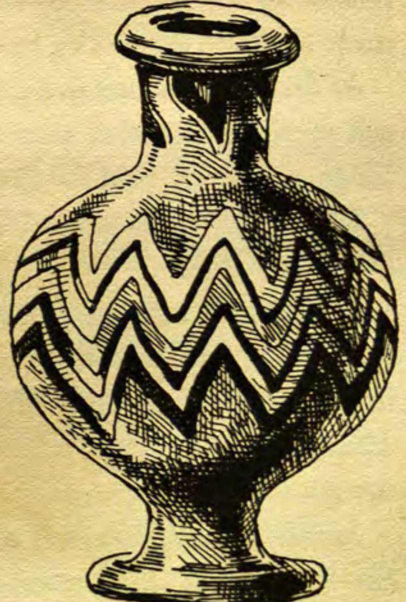
A. Lukas analyzed old Egyptian glass from the time of the eighteenth dynasty and the last centuries before Christ and proved that it contained 50—68% quartz sand, 1.5—10% lime, 9—29% soda and 1—7% potash. In small quantities the following were used, mainly as colouring: manganese, oxides of lead, tin, copper, iron, aluminium and sulphur.

The Egyptians used the trunks and roots of papyrus to heat the furnaces; Plutarch asserts, however, that they used the wood of tamarisk which reached the height of oaks in Syria and the Nile area. This later practice lead to a more thorough melting of the glass. The workers took samples of the viscous glass with pincers to test the colour. When the mass was fairly molten they let it cool in a barely ten inch wide pot. A sheet of glass, 1—2 cm thick, remained on the bottom of such a pot. This pot was then broken up, the glass foam was removed and a sheet of pure glass remained, free from sediments and foam, which was reasonably pure. This raw glass — later called hamonistrum by the Romans — was once again melted until it reached its dough-like consistency, then poured into a cylindrical-shaped form and under a metal plate was rolled with diagonal movements into a thin rod. This was then softened in the fire and extended to a three millimetre thick fibre which could be used for work.

To manufacture any vessel the Egyptian worker needed a cone-shaped copper spindle. On its end a soft quartz dough was attached in thickness corresponding to the size of the intended vase and all this was wrapped in a rag. String and rags left visible marks inside the vases. Now an incandescent glass rod was coiled around this core until it was completely covered. Several times it had to be dipped into the furnace and several times rolled until all threads fused. Only now different coloured threads were woven into this and then the whole article was rolled perfectly smooth. Then the top and the bottom were fabricated, handles were stuck to it and the metal spindle, which through cooling had shrunk in size, was removed from the inside. The outside of the vase looked magnificent, but its interior bore marks of the troublesome work process. It was never cut nor polished. Egyptian corals were made in the same way. Here the same thread was wound on a copper wire covered in clay, representing the size of the needle hole. When the coloured pattern was completed this wire was removed. The minute point where the thread was cut off is visible on each piece. The ornamentations on these Egyptian vases was entirely subordinate to the production process that has just been described. Patterns could be made by spinning different threads or by a kind of combing of the surface at regular intervals. If this combing followed only one direction the result was stripes; by alternating combs in both directions a half moon pattern was achieved.

Shapes and Colours

The earliest vases do not yet have the real shape of glass vessels. They servilely copy the stone and later the earthenware containers. To this we shall return when describing vessels of rock-crystal. Around the year 1 400 B. C. preference was given to the violet colour, beginning with the pale hue of the anemone and ranging to the dark blue mixture of copper blue and purple. Next in popularity was the so-called cobalt blue (Prussian blue), then a shade of sky-blue, then green, light yellow (whose composition is unknown), a rare red, orange, a shiny white, a milky colour achieved by the admixture of tin and finally black.



9. Vase belonging to Pharaoh Thutmosis IV, from Thebes. Reproduced from the works of A. Kisa, vol. I.

10. Balsamarium in the shape of a column. Reproduced from A. Kisa's work, vol. I.

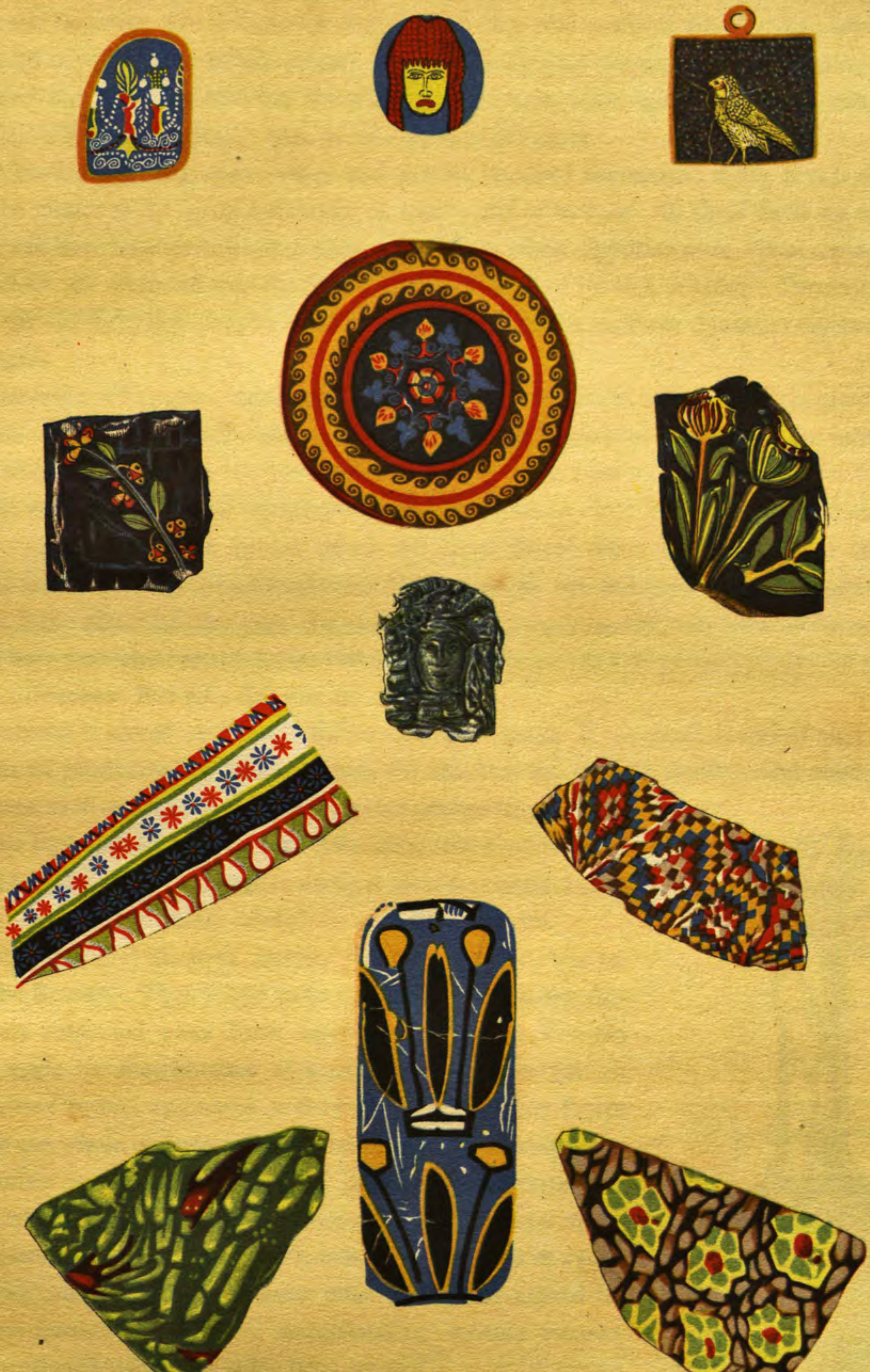
Glass Stones and the Oldest "Vasa Murrina" in Egypt

How easily all a-priori data can be shattered is proved most clearly by three discoveries which deserve a more detailed consideration: the first, a complete imitation of turquoise from the time of the first dynasty; the second, — roughly dated from 1 830 B. C. — represents already a direct antecedent of the millefiori (thousand flowers) technique; and the oldest is the famous mosaic of a calf. W. Wolf shows us some small pieces of glass from the first dynasty, which replaced some lost real turquoise on a bracelet. Two new discoveries originate from the time of the twelfth dynasty (2 000— 1 788 B. C.), both of immense value. One, a small glass mosaic, belonged among the jewels of a princess. It depicts a white calf with black spots on a light blue background. The frame of granulated glass consists of regular white, black and light blue squares. The second piece is a remnant — approximately 4 cm long — of a glass rod with a square cross-section. The name of Pharoah Amenemhet III appears in it in hieroglyphic abbreviations. This rod is the intermediate product of a special technique of working glass that had apparently been invented in Egypt, which after vanishing together with the Roman glass-houses, was re-discovered in the millefiori technique. The Romans who took it from the Egyptians called glass-vessels made in this way "vasa murrina." In this we can witness the great dexterity of the old Egyptian glass-makers. Its origin grew out of the actual work process of glass-making at that time, that is to say, fibre work. Different threads of glass were placed on top of each other in such a way that the cross-section of this bundle composed a sign, for example the name of a king. The bundle was then heated, the threads fused, retaining their form, however, whereupon the whole bundle was elongated, each thread becoming thinner and finer. This rod was cut into disks which then were encased in different glass or used as decorations for wooden objects. The glass-houses of the Ptolemies (300—48 B. C.) on Elephant Island made most artistic articles by this method.

At first, this method was used in jewel-making; later also those glass disks were shaped into vessels and open dishes which were admired by the ancients as incomprehensibly mysterious and valuable. Large sums were paid for them.

Glass disks carefully cut from the rods were set close in stone or metal disks in different patterns. Over these disks — called "marble" — the glass-makers rolled especially designed colourless glass vessels to which these glass disks attached themselves in the order in which they had been arranged. After being heated several times, the glass disks fused with the surface of the vessel and formed the desired pattern. It is said that hundreds of such glass-rods were melted into one single lump out of which a glass vessel was cut with — it would seem to us — incomprehensible trouble and care, as though it was the most unique of gems.

And so it seems that here we face the beginning of a technique which much later—after the Roman era — developed into a method of attaching such small disks on blown glass, which, of course, presupposes the invention of the glass-maker's blowpipe.



COLOUR PLATE V

It would seem likely that the Egyptian glass production originated at a time greatly prior to any proved by our concrete discoveries; for these are already real works of art. We shall have to wait for further results of archeology before we can ascertain today's assumptions with precision; namely that in Egypt glass was manufactured five thousand, if not more, years ago by a method unknown to us which, technically and artistically, was, of course, very primitive.

We now have about fifty entire vases and several hundred fragments; many reveal their date of origin by the names of the kings impressed on their walls or interior. All these finds are coloured, for either there can have been no colourless glass, or it did not please Egyptian taste. Glass replaced precious stones of which the diamond was the least popular because of its lack of colour. Conventionalism, so typical for the old Egyptians, applied also in regard to glass: for eighteen dynasties neither colour nor shape changed.

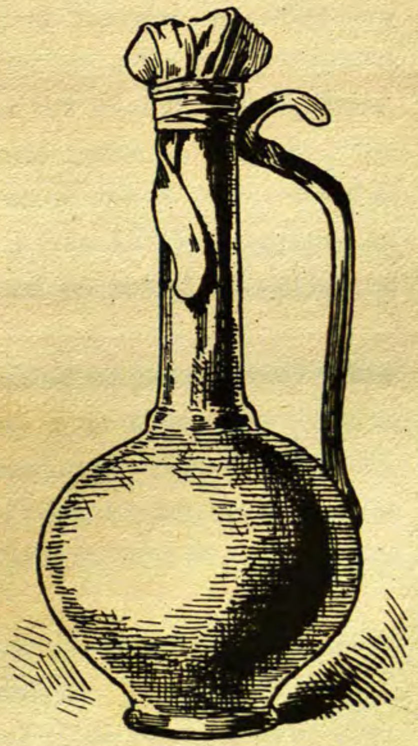
The culmination of Egyptian majolica production occurred parallel with the peak in glass production (in the middle of the eighteenth dynasty). The magnificent vessels of this period are technically and artistically admirable although the blowpipe and hollow glass were to remain unknown for centuries to come. But with the end of the twenty-first dynasty, i. e. about 1 000 B. C., this art died out, and later objects are mere copies which do not match the older pieces either in decoration or colour. Such objects were found all along the shores of the Mediterranean Sea and even in South Russia.

So far we have discussed the vase. To assume that it remained the only form of vessel would be a mistake. There were also beautifully curved goblets, bowls, and all kinds of receptacles for the dressing table of the princesses. But why did this art die out?

Simply because it served exclusively the small upper classes. If exported, it served only the owners of the means of production of other nations; for this was the time of slavery. And such individuals could promote such costly technique only within narrow limits. With the loss of the Egyptian supremacy over Asia Minor the production of luxury glass was doomed. That explains why it lacked a revolutionary development, and why it barely existed for such long periods.

In histories of glass it has been asserted that the blowpipe was invented by the Romans. That seems to be a mistake. It is known that the Etruscans imported glass from Egypt and that the Romans themselves made its acquaintance at a comparatively late period. The first written record originated in the year 54 B. C. When Egypt fell to Rome the whole of Italy was inundated with glass receptacles from Alexandria and the hitherto highly paid pieces suddenly lost their collector's value. These events, however, hardly suffice by themselves to explain such a complete, epoch-making breakdown in a production whose tradition and experience must have been missed by the new glass-makers. For clearer understanding another mistake should be mentioned which has since been refuted.

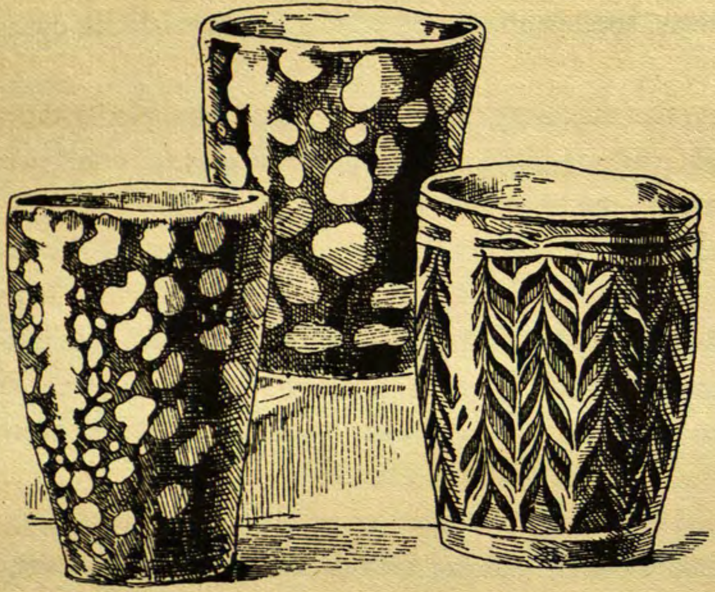
Near the village of Beni-Hassan in Egypt a relief was found in a tomb — dated back to the year 1 900 B. C. On it naked figures are working with long pipes near some kind of a furnace. For a long time it was believed that they were glass-blowers until F. L. Griffith



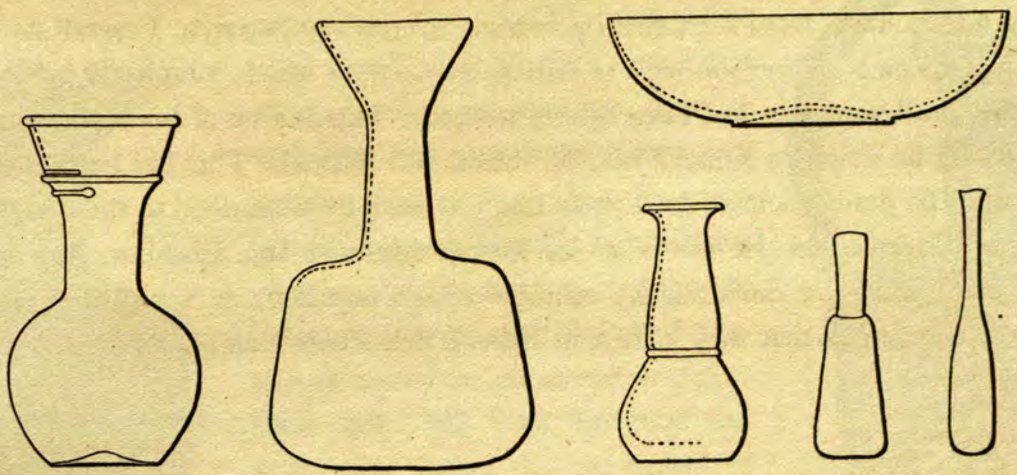
11. Small vessel from the tomb of Amenophis II, from Thebes. Reproduced from A. Kisa's work, vol. I.

proved beyond all doubt that here we were dealing with smiths bellowing their fire in an open hearth.

Albert Neuburger is of the somewhat forced opinion that the Egyptian glasses became opaque by a devitrification process known to us; and from this he drew the conclusion that the Egyptians knew the methods of decolorizing by the use of manganese. This assertion is untenable. We know how it arose: among the jewels some imitations of white brilliants have been found. Why did not this glass also become opaque? Clearly these are a few odd pieces for whose production the sand had been carefully sieved so that only the purest raw materials were added to the mixture.



12. Beakers of Princess Nsichons; Egypt; time: 18th dynasty. Reproduced from A. Kisa's work, vol. I.



13. *Shapes of hollow glass vessels, excavated at Punic Utica. Reproduced from E. de Sainte-Marie.*

MOULDED GLASS — A PHOENICIAN PROBLEM

The Melquart Turquoise

ALBERT NEUBURGER in his book "The Technique of Antiquity" maintains — contrary to the usual assertions in the sources at our disposal — that the old Egyptians had already mastered the art of moulding glass. From certain texts it is clear that king Sesostris had a glass statue moulded in the year 1643 B. C. No tangible proof for this theory is added. I would, however, include in this category the turquoise column in the Temple at Tyre, described by Herodot. But here we are not dealing so much with this column as with Phoenician glass-making in general. Herodot described two pillars in the Melquart Temple in Tyre — one cast in gold, the second — a block of turquoise. He did not know that these columns represented the oldest symbols of the Phoenicians. He could, therefore, not even conjecture that they were a remnant from the Nomad period during which the Semitic tribes would always begin setting up camp by erecting two columns — one of stone (massuba) and a green one, made of wood (date palm, acheru), and that they erected these idols in later centuries in gold and gems, respectively. Since he could not have known this and yet records the existence of the two columns, the fact may be considered proved.

But here we are concerned with something different: may we believe that the green column whose brilliance lit up the sacred temple nights was really such an enormous piece of precious stone, or was it not perhaps a block of moulded glass, coloured green? Such things are known to have existed, even if not of such enormous dimensions. It may even have been a glazed brick column, since we know of the existence of a similar column in the year 3 250 B. C. which was glazed in three colours. We also know that the walls of Babylon were made of enamelled bricks.

This last assumption, however, leads us in the wrong direction, since it doubts Herodot's intelligence. But the very legend of the turquoise block is fantastic, since it exceeds the frame of possibilities. A further question arises: is there a sound reason for the second view? Glass blocks of the size of a column must have been a technical novelty at that time. No proofs can be found for this in Egypt, apart from the note about the Sesostris statue. Herodot, however, was no braggard. His assertions are being proved almost daily, word for word, by new discoveries and research. I myself have discovered several connections on my three journeys to Africa, connections which completely proved his theses; even those that until yesterday had been utterly fantastic. This is true of his report about the Lake Culture, of which he writes as situated near an inland lake Tritonis. This has been identified as the Capsian culture. His descriptions of the Lybian customs have been ascribed to the Targian tradition, and were later confirmed in the works of the Berban historian Ibn Chaldun. And now we have reached the point when we can critically examine Kisa's assertion, as a result of whose prestige experts were so influenced that they ceased to believe that Phoenician glass production had existed in pre-Roman times.

Did the Phoenicians Invent the Blowpipe?

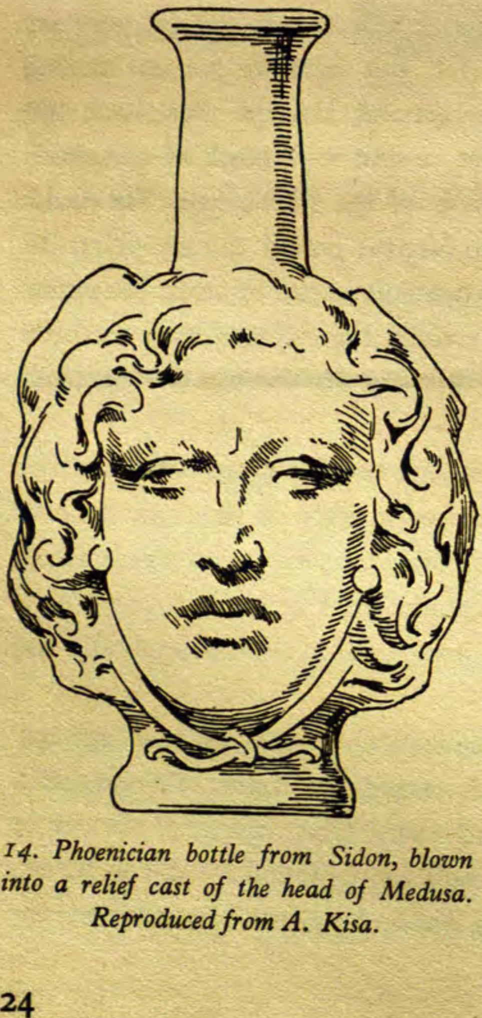
The Elder Pliny relates the following about the invention of glass:

"Once, Phoenician merchants lay at anchor in the estuary of the river Belus to cook a meal. Since, however, they could not find a large stone on the sand dunes to use as support for their kettle, they took lumps of soda from the ship's store room and lit a fire on them. Its heat was so strong that the sand fused with the soda, whereupon one of them called out in exitement: 'Gentlemen, we have just invented glass. Now we must pour water over it; then we'll go to Sidon to patent our invention; what business we'll open up in Egypt.' "

Of course, Pliny did not write this word for word — but no need for us to keep any closer to the truth than he did. Pliny, in contrast to Herodot, did not always examine his sources of information very critically and in our case, too, he blindly believed the tales of his contemporaries. There must be a grain of truth in these, since in Joseph Flavius' "Jewish War" there is a mention, at one place, that the sand in which the children christened in the River Belus and also the unchristened children played served as famous raw material for the Syrian glass-houses at Tyre and Sidon.

The question remains open whether this or a later age is referred to (compare J. Neústupný, pp. 133 and 167). So when Kisa on p. 96 asserts: "An independent glass industry arose in Syria and Palestine only at the time of the Emperors" we have to consider that just one round in the battle.

According to him, the Phoenicians learnt the art of glass-making from the Romans at the height of the Empire. Antiquity, that witnessed their monopoly in the glass trade throughout the civilised world of the time, is apparently not taken seriously. One has to read Gesell's "Histoire Ancienne de l'Afrique du Nord," I—VIII, to understand that if one can call any country of Antiquity cosmopolitan, that is to say, concerned with export, this is pre-eminently true of the Phoenicians and the Carthaginians, and particularly in respect to glass-making. At that time the latter was exceedingly



14. Phoenician bottle from Sidon, blown into a relief cast of the head of Medusa. Reproduced from A. Kisa.

15. Phoenician oinochoe of opaque yellow-green combed glass. Reproduced from F. Slade.

16. Phoenician oinochoe; colours: lapis lazuli and yellow, of combed glass. Reproduced from F. Slade.

expensive, and the Egyptian trade marks stood at such a high course that those practical industrialists, together with the exporters, were forced to a not very difficult fraud. And this particularly, as — in Gesell's authoritative view — the Phoenicians, lacking an artistic sense, concentrated on the export of shoddy imitations and worthless trash. After all, their harbours and workshops during the last period of Rome were real melting pots of the nations.

The purposeful intention of this undertaking is further supported by the fact that the Phoenicians came out of their anonymity as soon as the Romans took over Egypt and its lucrative workshops. Suddenly in Sidon hollow glass was blown into the negative casts of human heads. That was a bomb shell. The sensation-loving people of the time took such a liking to serial production that an excellent business developed and the Roman glass houses, willy-nilly, were forced to follow the lead.

When we later discuss how the Venetians found their luck in twice-plundered Byzantium, we shall recognize what thorough preparations this demanded. Then we shall also understand how foolish it was to assume that the Phoenicians who supplied almost the entire Egyptian export and sat as middlemen and carriers and store-house agents in the Nile delta had been unable during the course of two thousand years to introduce glass production into their own country, where it then flourished for twelve hundred years until the Israelites took over.

It is a certain fact that until the year 30 B. C. glass-blowing was unkown and that it was doubtlessly the Phoenicians who invented the blowpipe at the very moment when the prices were dropping, because the Egyptians were selling out, and the Romans were starting production.

The first preserved Phoenicians receptacles were intended for balsam and bear on their handles the signature of the artist (of whom ENNIO is the best-known). In the Bible there is only one mention of glass (Job 28/17) — and this in the last prophet of the Old Testament. Its price here is compared to the price of gold. Neuburger thinks that its fragileness complicated transport, and this raised its price. This is a false conclusion; for glass was also highly expensive right at the source, in the Egyptian glass-houses.

In Greece, glass was not generally known at the time of Aristophanes (450—385 B. C.) and apparently it was not produced for many years to come; otherwise they would not have been so amazed at the Persians drinking out of glasses. The little we know about this has been proved by Kurt Müller during his excavations in Pylos (Mycean era, 1400—1200 B. C.). The unexpected discovery of one beautiful fragment from a blue vase was tested technically and chemically by Rhodopulos, and he reached the conclusion that he was dealing with a potash glass almost identical with Bohemian crystal-glass which

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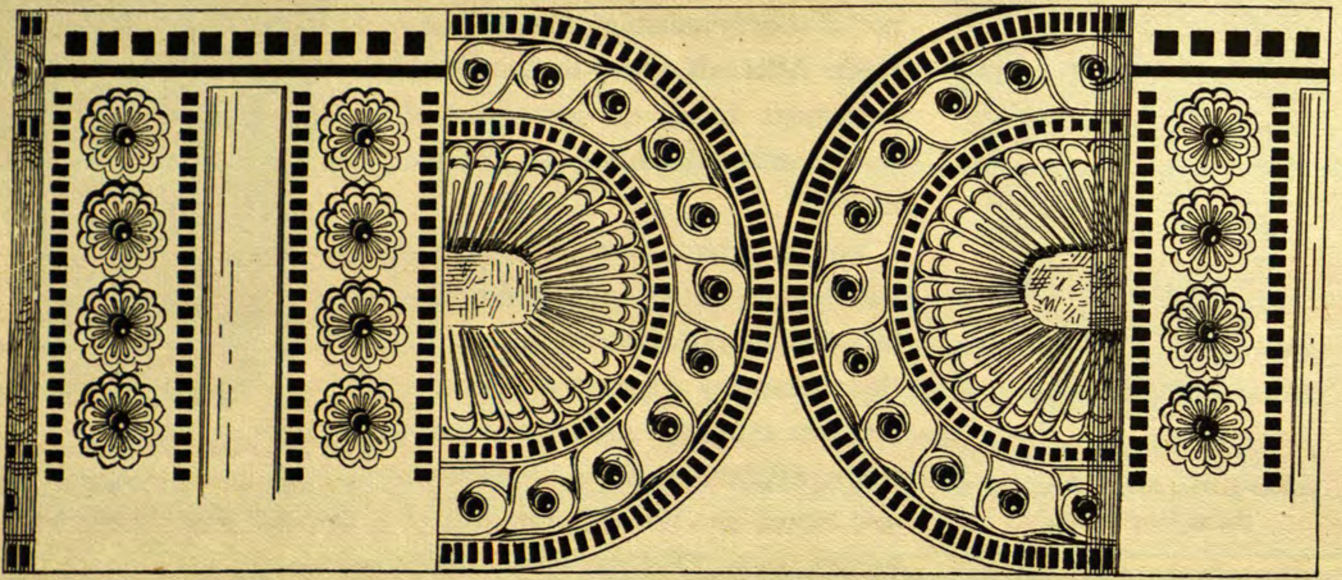
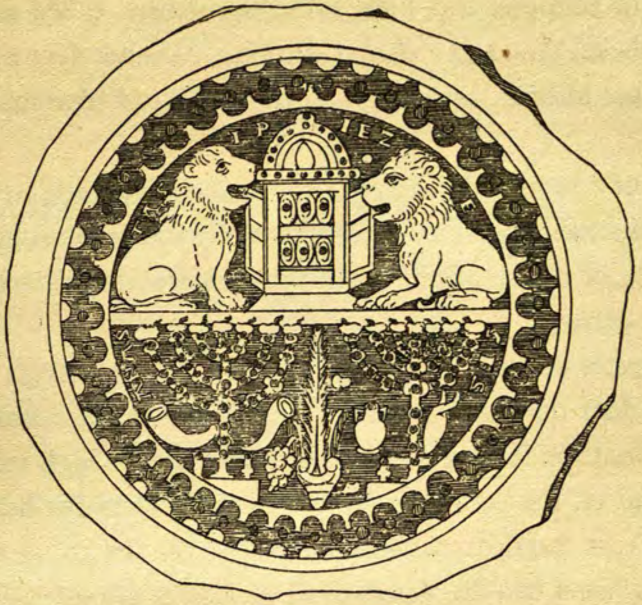
was difficult to produce. This had been coloured by means of copper oxide. Some other pieces in the Athens Museum point to this same ancient and almost incomprehensible age and their almost inexplicable Mycean origin. All this remains a mystery awaiting further patient research.



17. Mycenaean frieze of glass paste on an alabaster ground. Reproduced from K. Schuchhardt's work: "Schliemann's Ausgrabungen".



18. Old Jewish glass in the shape of a medallion.
Reproduced from Gerspach.

AND THE STONES BEGAN TO SPEAK...

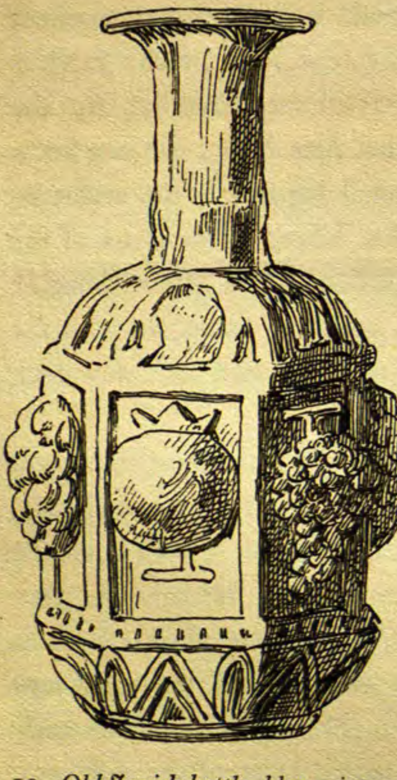
Glass in Assyria and Babylon

LONG DID WE HAVE to wait for the day on which pickaxe and spade would bring a document to light that might bear witness of this, the oldest glass. We had thought, of course, to find such a papyrus in the Nile valley and that one line of its picture writing would topple over all our knowledge. But the gods mocked those very scientists who had been asserting to the last that Asia Minor did not know glass-making until the beginning of the Western calendar. The unexpected happened: the archeologists have been finding an ever increasing number of cuneiform tablets during excavations of the hills that have formed in the course of centuries over the ruins of the big cities of Asia Minor. Imagine with what devotion the scientists poured over these mysterious letters, how they struggled with the mass of new knowledge; what victories were gained for contemporary research with each new deciphering. And then, finally, glass held the day.

A text, hardly 2×3 inches large, from the seventeenth century before Christ is the most important manuscript describing the history of the chemistry used in the process. It was found in Seleukia; the author: Mardu, the son of a Babylonian priest. He is also the oldest glass-maker known to us. To him we owe the recipe for a copper and lead glaze and for a green potter's clay. He calls the glass ZUKKU, which corresponds to the modern Hebrew word ZEKUKI; but each colour of glass bore its own name. For example, UKNU, SHIRSHU, SHIPRU, (in which we can easily detect the word saphire), DUSHU and one, containing especially much potash, called TUSKU. The tablet is intentionally mysterious, so that no uninstigated person might gain the jealously guarded secret of the mixtures. According to this recipe the copper glaze ABAR consisted of 60 shekel glass, 10 shekel lead, 15 shekel copper, half a shekel each of saltpetre and lime; into the mixture, called AGGADIT, they put 6 shekel lead, 14 shekel copper, 2 shekel lime and 1 shekel saltpetre. Marduk does not omit calling on the gods, to whom several spices were offered, especially mint (doubtlessly identical with the aloes of the Old Testament).

Then there was a lapse of a thousand years. For the next tablet originates from the seventh century, the time of the reign of Assurbannipal. This discovery by Kuyundshuk is even more eloquent and contains not only a description of the structure of the furnace, working directions, directives for heating, but also many recipes for glazes.

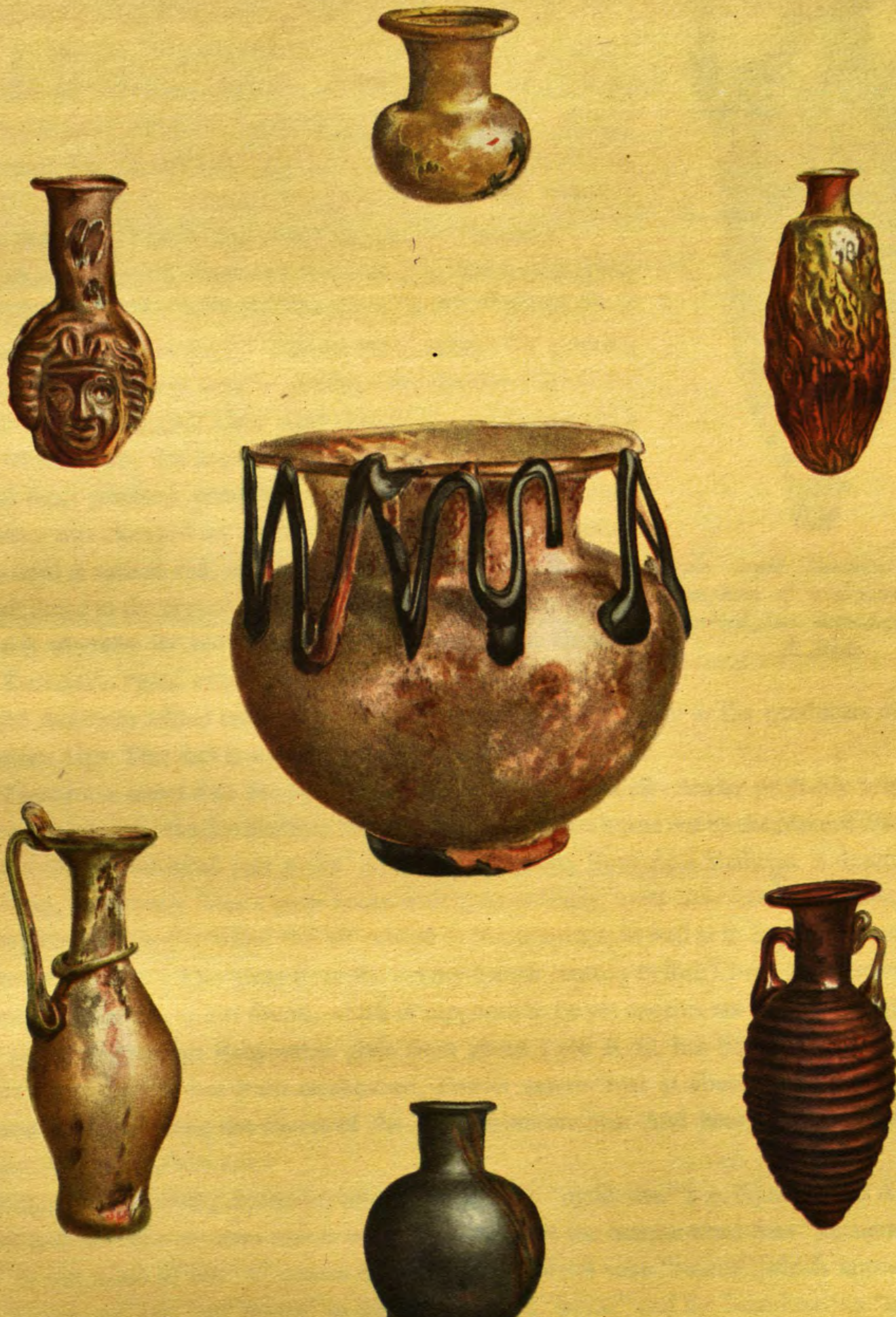
First, two kinds of furnaces are described. One type has four openings at the bottom; the second is dome-shaped and has a door that can be closed. Technicians in glass-making who aided the Assyrologues are of the opinion that the former was a conical furnace for high temperatures with a chimney at the vertex. The openings on the bottom brought the air close to the hearth. This enabled them to raise the temperatures up to 1 100 degrees centigrade since the fire could flame up high. The second, a dome-shaped furnace, is lower and the flames find an exit at the sides. It can be assumed that here we have an annealing furnace for lower temperatures, since the door prevented the entry of cold air. In the Assyrian text this process, which is thoroughly known today, is described poetically as a "red wind-blown sky, lit by flames, with the red of dawn in the copula". Bundles of dried wood from the rubber tree served as fuel. It must be remembered that at that time Mesopotamia was richly afforested. The fire was to be almost smokeless. The furnace was heated for seven days and then was opened again after four to ten more days. First, the glass mixture was ground up and then was poured into a melting pot with a well-fitting lid. This was not to be in direct touch with the fire. The "batch" was melted, grew red, yellow and then white, began to simmer, bubbles rose up and hissed. That was the sign that an alloy had to be admixed and only then was the mixture left to anneal. A note says that blue glass was cooled in water.



19. Old Jewish bottle, blown into relief cast. Reproduced from Gerspach.

The implements are also described: hooks, mixing spoons, a kind of small tablet or paddle. Three types of glass are mentioned: colourless, lead crystal and finally blue moulded glass. Although not all names of the admixtures have been established so far, we already know that the following materials were used for colouring: copper-, arsenic - and aluminium oxides, silver lead, sodium nitrates, shell lime as well as red and black colouring matter. Some of these were special preparations, which had to stand in water or other liquids for several days beforehand, since only the crystals of the sediments were used. According to R. Campbell Thompson (XXI pp. 4, 175, 194—6) the instructions continue in these words:

"When you have prepared the foundations of the glass furnace you must take care to choose the right month. If the workmen begin the construction of the furnace in the right month, you must supervise them and lend a hand at the work. Make sure you find a still-born child; carry it into the workshop taking precautions, lest a foreigner or an unclean person cross the threshold. On the day of lighting the furnace and the first charge offer the gods a sacrifice close to the body of the child! You yourself must light the fire and place the 'batch' into the hearth. Let the stokers



COLOUR PLATE VI

wash themselves clean before approaching the furnace and hearth. Use styrax wood for fuel; the logs must be sufficiently thick and without bark; they must never be left lying about in piles or bundles, must be cut in the month of August and stored under a roof of lamb skins."

This text shows that in the seventh century before Christ glass-making was still the exclusive monopoly of the venerable priests' cast, to whom it must have yielded a lucrative gain. K. Viktora mentions in this connection that the custom of the personal lighting of the fire has survived to this day. In the nationalized glass industry this right has passed to the manager of the works. What an ancient ceremony!

The long enumeration of recipes of Assyrian and Babylonian glass production published by R. Campbell Thompson in his "Dictionary of Assyrian Chemistry and Geology," Oxford 1936, reveals the amazing fact that the Assyrians knew how to produce the necessary acids for the production of aqua regia. They used this in the production of a purple glass which to this day is generally known under the name "gold ruby", whose most precious component was gold, dissolved in aqua regia. This water was changed six times; then the gold dust was heated in a clay pot until it turned red, which took many days; then this was added in small doses to the crystal glass that had frequently been dipped into the liquid; whereby its red colour became transparent. Cassius' purple and Kunckel's "gold ruby" were produced in the same way, except that the Assyrians added two and a half to three times as much gold as the producers of "gold ruby" in modern days. This fact is a surprise to glass experts.

20. Small Phoenician toilet amphora of transparent blue, combed glass. Reproduced from F. Slade.

Beck and Thompson assert that the Mesopotamian glass found in Tell - Asmar probably originated from the second third of the third millenium before Christ; this is also borne out by the place of discovery. This glass was already coloured pale green. A similar old piece, from Abu-Shahrein is described as a pure blue lump, doubtlessly from a glass-house which, accordingly, must have been the oldest in the world. Beck's glazed pieces prove that this art existed in Mesopotamia as well as in Egypt. Here we have the same blue-green colour. This glaze from the twenty-fourth century before Christ is transparent. At Ninive a copper-red glass piece was found, which is supposed to be yet another six hundred years older.

The blue and blue-greenish Babylonian glass from about 1 500 B. C. has been chemically tested. In both cases a lead content has been established. Fowler asserts that at about 2 500 B. C. opaque glass was being produced along the shores of the Mediterranean Sea. And here is yet another interesting and perhaps informative note:

The word enamel is probably derived from the Greek verb "meldomai" i. e. liquidize. Its Assyrian form is "eshmaru" and one assumes that it is not identical with the Semite word root "hashmal", but that the "r" in the place of the "l" comes from the Aryan word root "smard" which appears still today in the meaning of "fats" or "butter" in the English word "smear" and the Scandinavian "smoer", the German "schmieren". Many scholars conclude from this (following Thompson) that glass came to Assyria from areas which had not been inhabited by Semites but Aryans.

From all this and many other facts, which cannot all be given here, it can be concluded that there is an explanation for the excavation of the glass bead in the pre-historic layer under the temple tower in Assur which astounded Bruno Meissner so much. The Assyrians and the Babylonians knew glass almost as long as the Egyptians; that is at least five thousand five hundred years ago. Their industry concentrated, however, on making glazes, a technique which they mastered as perfectly as the inhabitants of the Nile regions. What we have read about the Assyrian and Babylonian furnaces we may equally well apply to Egypt. Here as there, the art of glass-making was firmly in the hands of the priest cast. The lack of technical development during three thousand five hundred years is surely due to their firm attachment to traditional forms right up to the dusk of Antiquity. In such an environment there was no place for revolutionary inventions, such as the blowpipe and hollow glass. So that today we may assume with growing certainty that the blowpipe was invented in Sidon. Future excavations will, doubtlessly, confirm this theory.

THE SOCIAL AND ECONOMIC FUNCTION OF GLASS

Whom did this oldest glass serve that had arisen in the almost unbelievably patient hands of the Egyptian potters at such an early period—this glass whose production secrets fell, thousands of years later, into the hands of the Roman conquerors as a valuable loot? A writer depicted this most clearly — though involuntarily — when in the year 279 B. C. he described the procession held in honour of Ptolemaus II Philadelphos, the pharaoh:

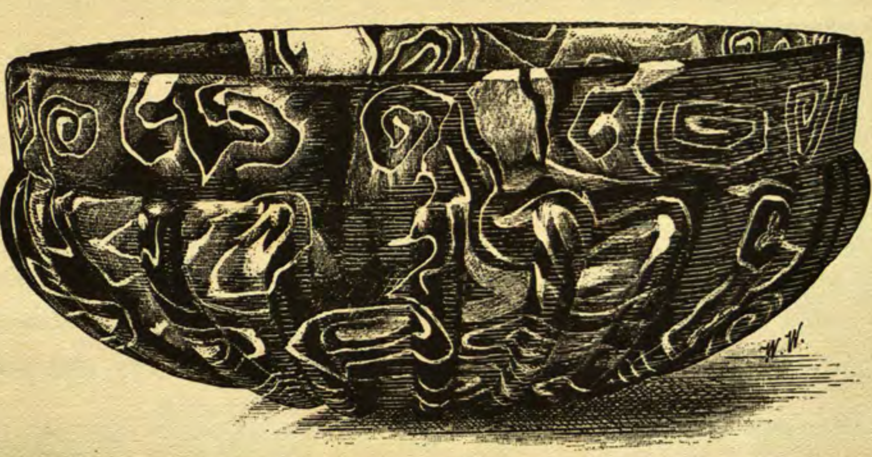
"1 600 children walked in procession, half of whom bore golden, the other silver vessels. The people were shown also an enormous waggon with silver receptacles; among them a mixing bowl for six hundred quarts; ten large wash basins; sixteen large milk receptacles, thirty tables, thirty tripods, and many other implements of solid silver. Another waggon carried gold vessels: a jewel case, ten ells long; two glass casks, four tripods, ten jugs; an altar, three ells tall; a golden thyrsus, 90 ells long, and further articles of gold, silver and spices."

This is a description from Hellenic Egypt and it especially mentions (prof. Goll) that the first Ptolemies were at their time considered very rich monarchs of Antiquity. It is noteworthy that in this enumeration glass casks figure side by side with the gold treasures, side by side with the gem-filled jewel box. And when all this is enumerated, and when we see that in the country in which glass originated and had been produced for over three thousand years only two glass casks were present, then the immeasurable value ascribed to it becomes truly clear.

We have mentioned a kind of glass called "Vasa Murrina" by the Romans. Emperor Nero paid 300 talents for a single such goblet. In modern values that represents 7 800 kg of silver or gold — a simply fantastic sum. This leads to the conclusion that glass with its beautiful forms had no other function than as ornaments, and that its value was weighed in pure gold. This also explains why the Phoenicians never admitted that they were not trading exclusively with Egyptian glass, but often with their own imitations of the same, particularly trinkets. These they apparently offered as precious stones wherever and as long as it was possible. They could dare this without the least scruples, since few people at that time could have convicted them of fraud.

That also means that until the height of the Roman Empire glass was the property of the members of the upper strata of society. The development curve of this luxury article differs from the increasing means of production of their society; it does not run parallel with their advance.

And so here we have the cause for the deep decline in the quality of the Roman glass after the beginning of the medieval society.



21. Coloured Roman cup, carried out in "murrina" technique. Reproduced from A. Kisa, vol. II.

THE AGE OF ROME

THE INFLUENCE OF THE CHANGING MEANS OF PRODUCTION began to make itself felt. Although it would have seemed natural, I have not been able to gather from any source that the invention of that one yard long, hollow, iron tube, with the half inch wide opening — which, in fact, represents the blowpipe — revolutionized the production of hollow glass. An important factor in this invention was the change in the entire melting process which had been introduced shortly before.

For what could an Egyptian glass-maker have done with the blowpipe, lacking, as he did, a sound understanding of the melting process. The fundamental change of the furnace acted as a driving force that caused a leap forward in glass production. This new glass furnace changed the tedious art — so like jewel-making — and the secret, which had served for the enrichment of the select few; and glass-making became a lucrative branch of industry. Soon the production turned to perfect and versatile vessels whose quality, manifold types and decorative possibilities have in principle not been surpassed to this day.

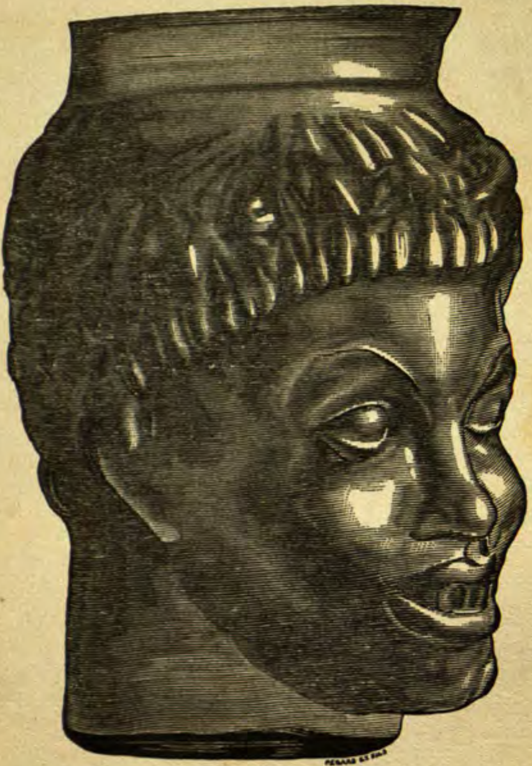
Now the time has come to turn our close attention to the glass-houses.

A PICTURE OF THE GLASS-HOUSE IN OLD ROME

The Treble Division of the Furnace

It has already been stated that in the oldest times glass was simply melted in pits. Much later primitive ovens appeared. One of these was dug up in a semi-collapsed condition by Sir W. M. Flinders-Petrie.

According to Kisa, the roots and stalks of the papyrus reed were used in Egypt to attain tall flames and later on, the terebinth wood yielded a more intense heat. But even this great improvement hardly sufficed to raise the temperature to the point at which glass melts. It proved necessary, therefore, to divide the work into two separate processes. In Bohemia too, this was the case at the beginning. First, the individual components were melted in the so-called "frit oven" (a word of Italian origin) and this intermediate product was purified after long and troublesome re-melting until it became



22. *Small Roman vessel, blown into a cast of a Negro head. Reproduced from W. Froehner.*

suitable for handling with the blowpipe. For the "frit" the "batch" materials of the future vitreous mass were baked in flat clay pots (25 cm in diameter und 7¹/₂ cm in depth) at a heat of roughly 1 000 degrees Centigrade. The escaping carbonic acid formed foam and bubbles on the surface of this mass during the primary melting, whereas at the bottom of the pot the worthless sediments remained — wood ash slag which had been added directly and not, as today, in the form of pure soda and potash.

After melting, the pot with the molten raw glass was left "standing off" to cool; then it was taken out of the pots, and once again heated in a deeper pot to form pure glass. This process was later developed in such a way that the "hamonistrum" — as the Romans called this reddish-brown matter — which after removal of the bubbles turned into pure glass, was scooped into other pots at a high temperature.

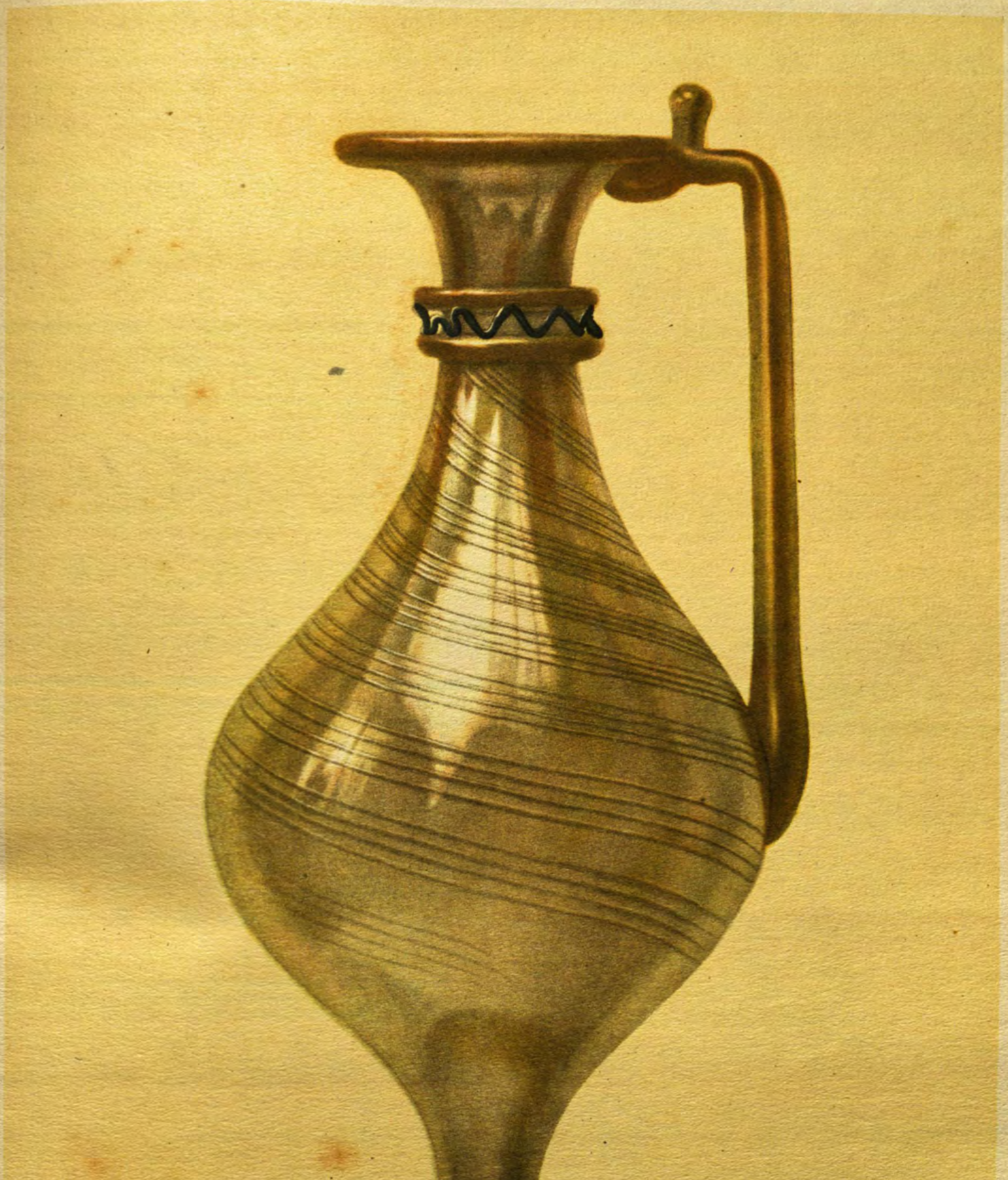
The third section served as an annealing furnace in which, just as today, the completed glasses were placed to allow for the unequally strained conditions within the glass. The glass here was kept at a low temperature which was carefully maintained, according to the type, size and thickness of the glasses. That is the basic technological reason why all old furnaces were built in three sections. Moreover, it must be taken into account that neither potash nor soda were added in pure form to the mixture. Since the production of raw glass blocks was dependent on the proximity of glass sand, these blocks were often transported to other glass-houses which were not immediately in the neighbourhood of such sand quarries, but in places where better conditions for further treatment of this semi-raw material existed.

Furnaces According to Heraclius and Theophilus

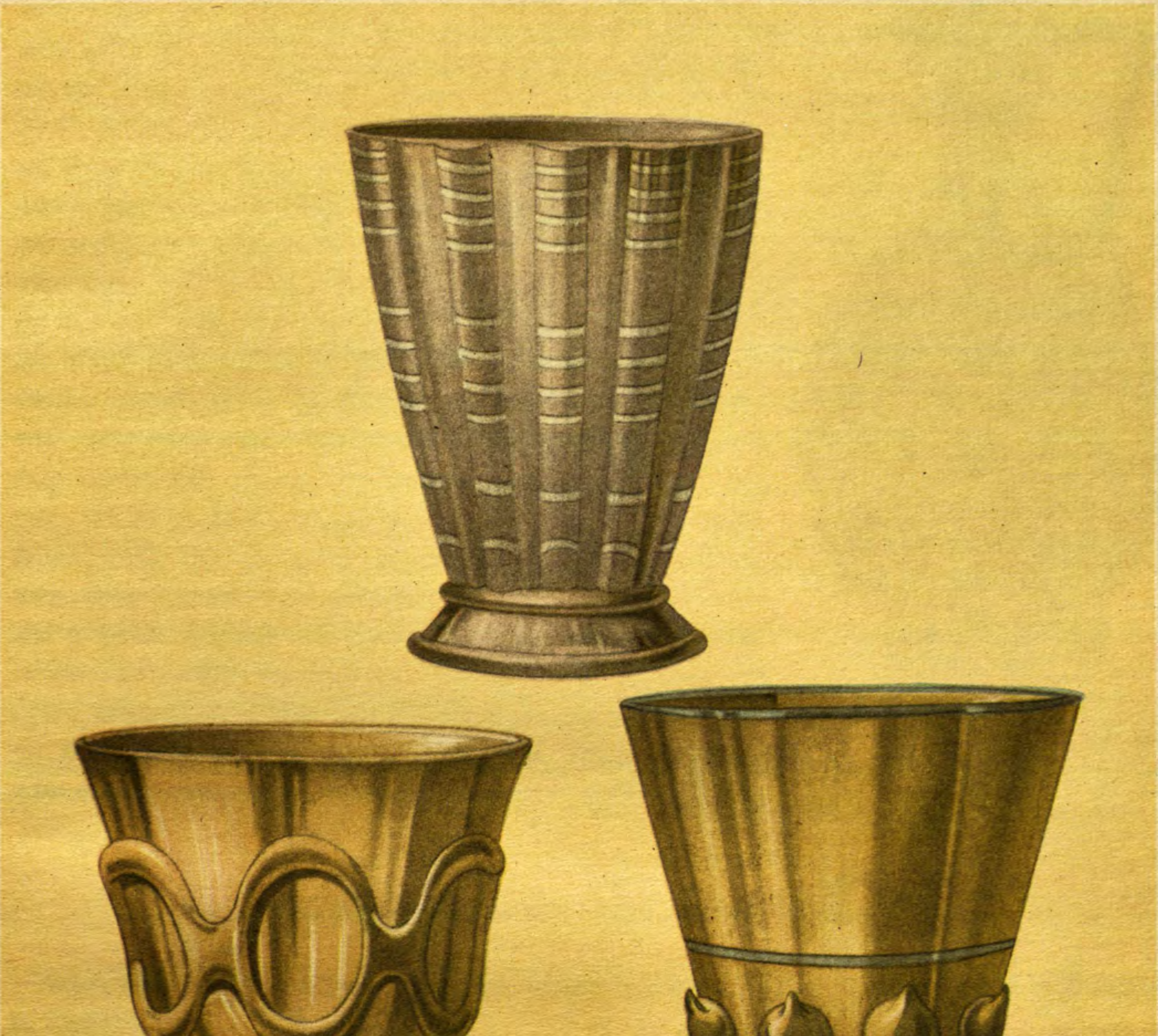
We owe further details about the shape of the ancient furnaces to these two scholars. Heraclius describes their structure as follows:

"Build a furnace and cover its walls with clay. The bottom should be half an ell long, equally high and quite level. In the ground leave an open ditch; here the hearth will be. Over this ground shape three chambers (archae) in which there must be openings like windows. The central archa should be large with two windows, one on each side. Inside at the far end of the opening place a pot of mature fire clay and into it put ash and sand. Make another archa on each of its sides; the one on the right-hand side smaller than the left. In the left one, the glass will be melted day and night until it becomes viscous like honey. Then take it out of the pot with a ladle and heat it until it becomes quite white."

The monk Theophilus also left us a description of the old glass furnaces. He says that the furnace should be in two parts, one part for melting, the other for annealing. Such a furnace had eight holes for the melting pots and two fireplaces, as well as a dome-shaped roof. It was surrounded by a wall with holes through which the pots were placed into position; next to it stood the annealing furnace. Then Theophilus continued: "Make this oven from stone and earth, fifteen foot long and ten foot

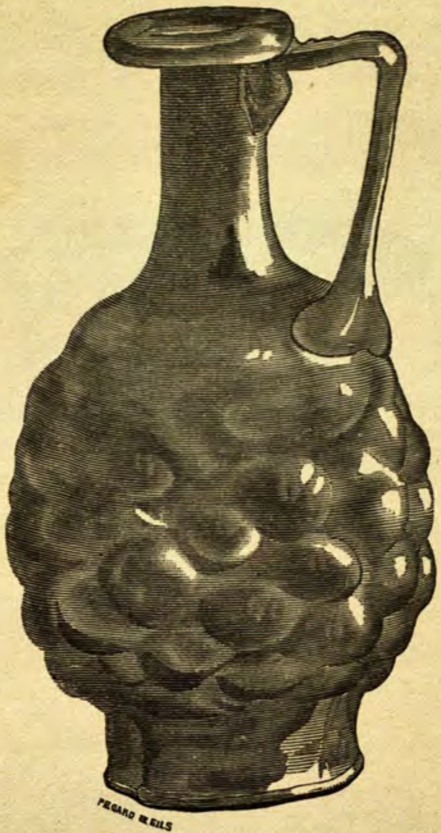


COLOUR PLATE VII



COLOUR PLATE VIII

wide. First make the foundations on each long side, one foot thick and in the middle make a firm, level hearth from stones and clay and divide it into three equal parts. Divide the two parts by a wall and the third part also by such a wall. Then make an opening along the side wall through which fuel and fire can be introduced; build a four foot high wall all around, make another firm and perfectly level hearth and let the transverse wall rise up somewhat higher. Then make four holes along the one long wall of the larger chamber and four more in the other in the middle of the hearth whither the pots are placed; further two holes in the middle through which the flames can rise up. Around it build a wall, make two square windows, one hand long and wide, one on each side opposite the holes. Through these the pots are fed and taken out. In the smaller room, too, make an opening in the middle of the hearth, near the central wall, as well as a window, one hand long, along the outer front wall, through which one can introduce and withdraw anything connected with the work. If you carry out all these instructions you must give the inner room the shape of a dome, inside a little higher than half a foot, so that you can make the hearth quite level on top and with a three finger high edge. This oven is called a work furnace."



23. Roman bottle blown into a cast representing grapes. Reproduced from W. Froehner.

A Late Roman Furnace in Britain

Anton Kisa describes a late Roman glass furnace excavated in the years 1899—1900 at Wilderspool in England.

"Along the northern section of the road three platforms were found lying at a depth of two feet, only a few steps from each other, in a position parallel to the road. Each contained two similar melting furnaces. At the bottom, the platforms consisted of a layer of ground flints; then came a layer of bricks and finally clay, which rose three to four inches above the furnace, which it enclosed on three sides, and around which it formed a one foot wide circle. A similar layer of clay separated the two furnaces that lay next to each other. In the furnaces of the first platform there was an oval pit in the centre to which a fan-shaped opening lead for heating and stoking purposes, that penetrated the outer wall and which was closed from without by a carefully bricked-up circular fireplace. One furnace had a groove as lay-out hole on the opposite side which ran horizontally; the other had this running at right angle to the heating arrangements along the side wall. The two fireplaces in the adjoining furnaces were not in identical positions. Those of the one furnace consisted of fireclay, decorated with twenty-one circles stamped on it, each two and a half inches in diameter; those of the other were carefully covered with stone slabs and large bricks — 11-15 inches in size and $2^{1}/_{2}$ inches thick — which had burst in the heat. Apparently these two fireplaces served for different degrees of heat. The one, the melting furnace, had the lay-out of a normal baker's oven. Judging by the thickness of the red clay found in it and the quantity of fragments with chalk plaster which covered the ground, it must have been dome-shaped originally. The other furnace seemed to have been used for heating the kettles or melting

24. Roman glass cup and two amphoras of coloured glass. Reproduced from F. Slade.

pots. Under the floor of the fireplace a slanting pipe-shaped channel — six to seven inches in diameter — was situated which surrounded the entire platform like a rabbit hole. It began on the north-east corner at a second smaller fireplace of fireclay and ended on the opposite side — the southwest corner — in two openings, at a distance of over 32 ft. This channel was still open and throughout blackened by soot. Near the stoking hole of the second melting furnace this widened to a chamber of one square foot which was covered by a vaulted fragment of an amphora, firmly set in clay.

The two furnaces on the second platform differed from those on the first in arrangement and probably in destination. One was flatter than the previous ones and almost square. A sandstone slab, seven inches high, had been attached in front of the opening. The other was of long, oval lay-out and apparently was not destined to hold melting pots. A large quantity of red clay which filled the interior of both of them, broken fragments of glazed loam, which had melted into the floor, a circle of soft clay along the upper edge from which the chalk plaster had crumbled off — all this leads to the conclusion that it, too, was arched. In this second furnace intermediate floors below the fireplace made three sections. Towards the middle of the second section the two holes led to the fireplace above it. A third led into the open; through all of them bellows could fan the fire. The intermediate floors had been built to make possible different degrees of heat and to save fuel. They were not replacements of a broken hearth, since all of them were in excellent condition. The stoking hole was arched and widened towards the outside. In front of it stood a well-built hearth of fireclay, almost semi-circular, two foot four inches in diameter. Around it, in similar height a layer of fine, white sand had been piled up, such as was found in plenty in the neighbouring fields and which was used in earlier times for glass production in Warrington.

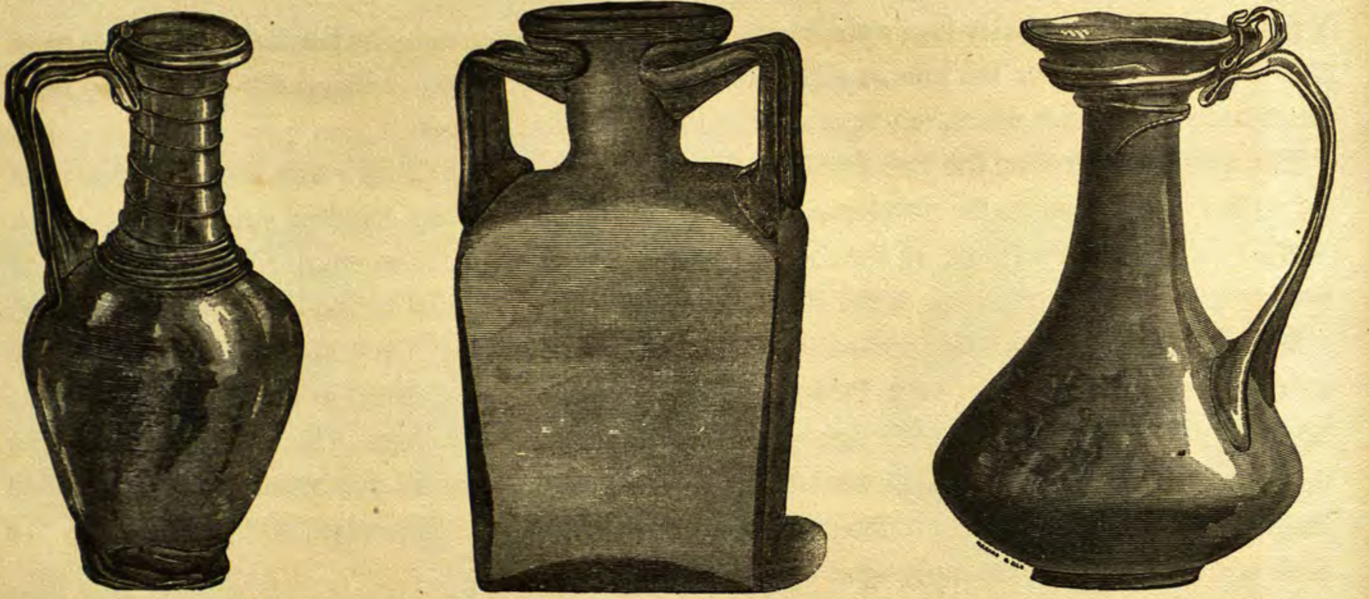
The two furnaces along the third platform were also oval-shaped. A semi-circular hearth of fireclay lay symmetrically in front of its two openings and was also decorated with imprinted, ring-like rosettes."

The remnants of the glass ovens discovered by Sir Flinders-Petrie in Tell-el-Amarna showed that the pots for raw glass were ten inches in diameter and three inches in depth. By their side broken fragments of cylindrical clay jugs were found, 7 inches in diameter and 5 inches high. These jugs were placed upside down into the hole as supports for the flat pots and crucibles, as can be gathered from the colours of the glass which ran from their bottom towards the neck.

The difference between the two furnaces described is very great. They result from the change in the means of production, the development during the course of fifteen hundred years. The evolution of the world and the progress of the slave system were enormous; for we must not forget that we are dealing with Rome at the time of the Emperors which forms a special period in regard to technique.

Who was the glass-maker who melted the raw material for the vase of Thutmosis III? A priest — more we do not know. In the year 14 A. D. a glass-makers' guild was established in Rome, which found no equal for a thousand years — throughout the whole of the Middle Ages. This date means far more than the mere statement that glass was being made in Rome; it shows us that by this time they were no longer priests, but people of a different social rank who concerned themselves with glass-making. We shall see by a concrete example what that means.

25. Smooth old Roman glass cup. Reproduced from W. Froehner.



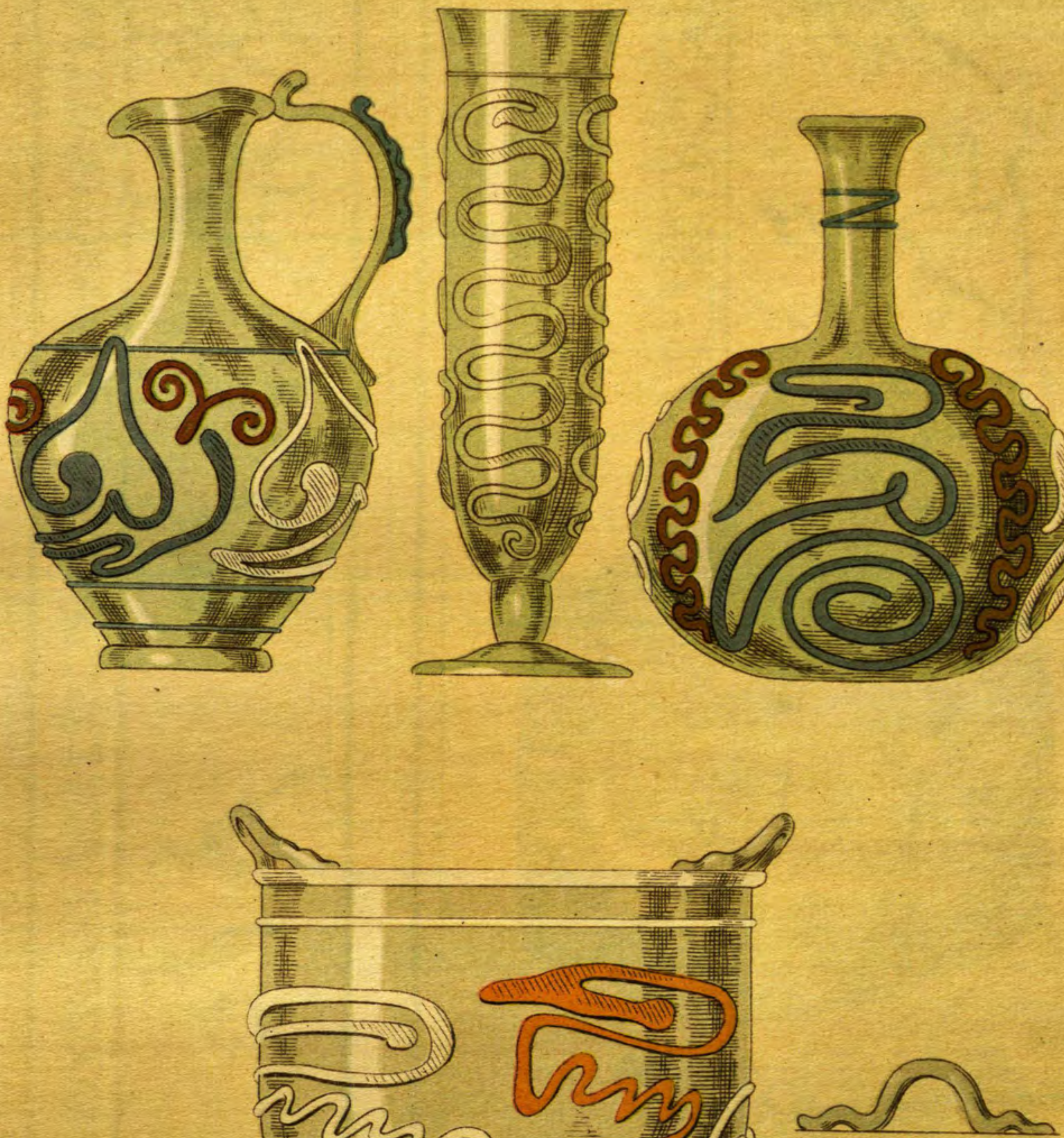
26. Old Roman glass: jug with fired glass threads decorated in geometrical patterns; square, coloured vessel with handles and a plain carafe. Reproduced from W. Froehner.

THE BLOWPIPE AND ITS OLDEST PRODUCTS

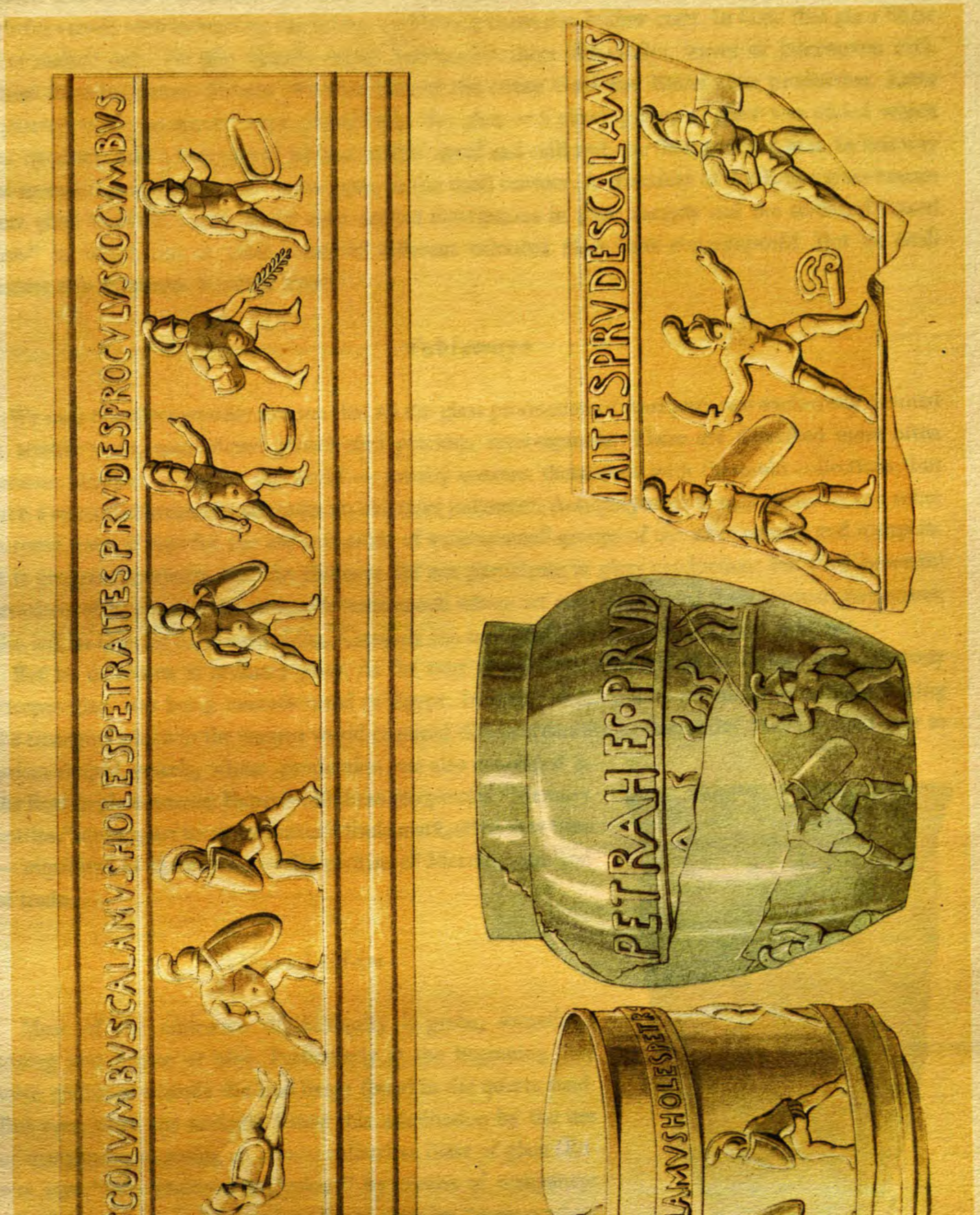
The Technique of Glass-Blowing

ROUGHLY AT THE BEGINNING of our era the glass-maker's blowpipe was discovered, probably in Phoenician Sidon, and was then possibly taken from conquered Carthage to Rome. Its use meant a real revolution in glass production, coming simultaneous with the change in the ground plan of the furnace. The blowpipe enabled the glass-maker to give vessels those shapes which we find to this day, and also to attain those thin walls which befit this sparkling, translucent matter. The iron tube had been widened at one end into a knob or was equipped with a trumpet-shaped opening. The other end held a wooden mouthpiece. When the glass-blower wished to make a simple cup, he dipped the end of the tube into the viscous glass, "gathered" the appropriate quantity which at a slightly cooled stage had the consistency of honey. Under constant rolling or manipulating with simple tools he blew the glass into a knob through the mouthpiece. By swinging it, or rolling it on an iron or metal slab, by shaping it with a metal paddle or by blowing it into a mould the vessel was given the desired shape. The most natural form is the ball, since angular outlines resist the technique of blowing and are used even today only rarely. The necks of the bottles were either made separately and attached to the vessel after it had been cracked off the punty, or they were created out of the same piece by extension of the glass bubble at its upper section. By this latter method the glass was attached at the foot to the punty (i. e. melted on) and was separated by cracking off. After re-heating the glass-blower "turned" the neck with his hand.

Particularly attractive are the special shapes of the handles which the Ancients knew how to make with masterly perfection. A strong round or square glass fibre was attached to the vessel, bent gracefully and fixed to the neck. Many vessels have been preserved with one or two handles. The most manifold creations arose by pressure with tongs or folding and pressing. Most popular were the bottles which were blown into moulds representing heads, shells or grapes; such were found in



COLOUR PLATE IX



COLOUR PLATE X

Sidon. The Rhine glass-houses perfected the Phoenicians inventions, as they learnt to make their delightful vessels with interesting ornaments by blowing them into hollow casts. In Gaul thin glass fibres were melted onto the thin vessels, which surrounded them like circles, waves or interwoven nets. These threaded glasses formed the main part of the entire Gaul and Rhine glass production. Later separately-made ornaments were pressed into the glass or a glowing drop of glass was added which was extended into a long thread with incredible speed and skill and was then attached to it. In this way the so-called „snout decanters" were made in the third century. A speciality of the Rhine glass-houses were glass drinking horns, which even carried inscriptions in glass threads and the so-called "cased glass" in which two or more layers of different coloured glass were superimposed. But we shall discuss this technique in detail later.

Tableware

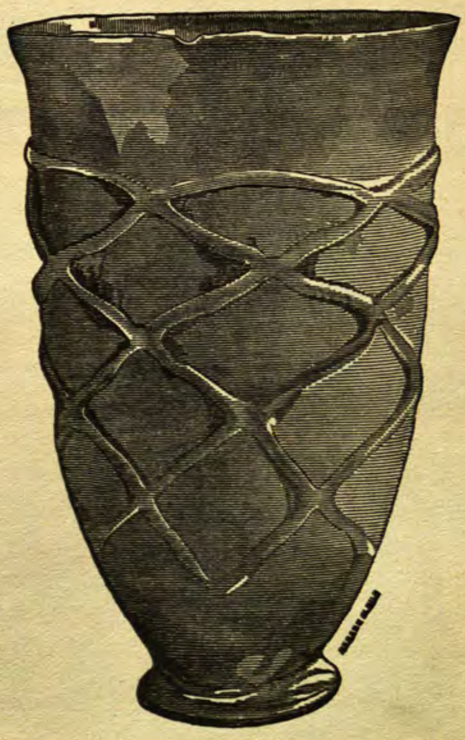
We may not automatically assume that all the glass production of Antiquity was exclusively devoted to artistic vases, magnificent goblets and precious extravagances. These are described more often because idealists — lost to the world — usually concern themselves with these old collections; but such a one-sided attitude guarantees no objective judgment. Antiquity tried to make glass serve a sober purpose, even if only for the use and profit of various small groups of the slave owners and usurpers. It is general knowledge that the Hellenes did not participate in glass production; but their powerful invasions of Egypt and the entire Hellenic epoch whose art even dominated their Roman conquerors, also left its imprint on glass-making. Certainly the beautiful interiors at Pompej are pure art.

But let us return to ordinary glass. At the time of the Ptolemies and later, simpler and relatively cheaper glass was being manufactured in Egypt. In order to store it as rationally as possible during the transport which in the ancient world required different conditions than today, they changed over to prism-shaped vessels, whose production was also continued in the Roman glass-houses. Experts call these receptacles "Mercury bottles," since apart from the maker's trade mark, often they bear — imprinted in the bottom — the picture of Mercury, the god of trade.

Coloured Glass

Most of the tableware of Antiquity is green, sometimes toning into brown or blue. Particularly at the beginning they were unable to exclude the iron oxide found in the quartz sand. But even when the ancients learnt this elimination by the use of manganese, attaining an almost colourless mass of glass (Roters says "they removed the colour" by means of manganese oxide), they continued to produce cheap glass by "mass production" from the coloured raw material.

The earrings preserved in the Berlin Museum prove that the old Egyptians could remove the colour of the glass. Technically this was tremendously difficult, possibly merely a matter of chance. Moreover, as already mentioned, the Egyptians loved



27. Old Roman beaker, decorated in geometrical pattern with fired glass thread. Reproduced from W. Froehner.

coloured glass; their range of colour was immensely delicate and highly cultivated. At the beginning of our era, colourless glass was a regular feature of Egyptian production. But along the Rhine valley and in Gaul preference was given to white glass — resembling crystal — for all more distinguished glasses and vases. In spite of this the various shades of coloured glass were very popular among all sections of the population. Coloured vessels with coloured decorations were typical for the first centuries after Christ Emerald green glass seems to have been a discovery of the Alexandrian glass-houses during the last century before Christ; the engraved ornaments were inlaid with gold leaf which created the impression of a jewel set in gold.

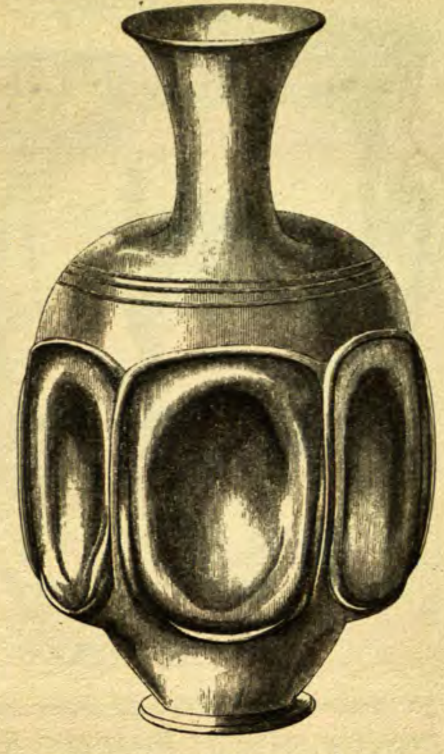
The Composition of Glass

In this chapter on glass-houses we must say something about the composition of glass, a point on which we have so far only touched. Since its first origins the mass of glass consisted of silica in the form of pure river sand. To ease smelting a number of auxiliary materials were added later: mainly vegetable alkali and ash which contained soda, potash and saltpetre. At this time of absolute ignorance of chemical reactions the impurity of these materials frequently caused an accidental colouring of the final product; it may have been a long time before it occurred to someone that a certain matter can be given a certain colour by adding this intermediate product to the basic mixture. But even simple people soon recognised that glass became easy to work by the addition of soda; became harder by the addition of pottassium and lighter by the addition of lead; the latter, moreover, reflected the light. And this they used in making bijoutery.

28. Slim Roman jug with diagonal fluting, of light green glass. Reproduced from F. Slade.

Heraclius related that with a light, but solid wood sand can be fritted by the addition of copper and saltpetre similar to ores and can be left to harden as lumps of raw glass. This glass then had to undergo further melting, some of it was blown, some cut on the wheel; the rest polished like silver. The best variety was that white, crystal-like glass — which soon replaced silver and gold goblets. Three parts of potassium nitrates were added to the pure washed sand; all was melted and then taken to the real glass furnace for the chief job. It may be assumed that this was a simple, well-known process. To reach an opaque, milky tone the ancients used zinc oxides, for translucency arsenic, and manganese for decolorizing. Even "gold-ruby" was already known. They made lime by pulverizing alabaster, a purple-coloured marble from Carrara. Flints were also ground up finely since they proved more useful than the river sand. Pliny's report that rock-crystal from India was used for this purpose is untrue. This did not happen until the fifteenth century in Italy. The rock-crystal here must have meant quartz. The same author named also magnetite under different circumstances which (according to Lens) melted well with glass. The addition of a small pinch coloured the glass deep black. Apart from several metal oxides which served for colouring the glass, also fossilized snail and shell sand was used; this contributed to the colour and brilliance of the glass. Pliny and Theophrast speak of copper exclusively as an admixture. According to Lens, the copper oxide gave an especially thin-walled hollow glass with a magnificent cherry-red colour.

Recent research and analysis by German scholars supports this old knowledge. The most important discovery is the manganese used by the Romans.Roters found it in the glasses at the Saalburg Castle. Somewhat sensational seems his assertion that the Romans no longer used copper for green colouring like the Egyptians, but iron dioxide; iron trioxide for a red-brown colour, brown iron ore for black and manganese for a violet colour. Such admixtures are customary even today — as well as chromium for green, antimony and uranium for yellow and orange with which — according to K. A. Hoffman's analysis — the Romans were already acquainted. (This, however, is an absolute impossibility since, of course, the Romans did not know of the existence of uranium.)



29. Magnificent Roman bottle of crystal glass, blown into a relief cast of unusual shape. Reproduced from Felix Slade.

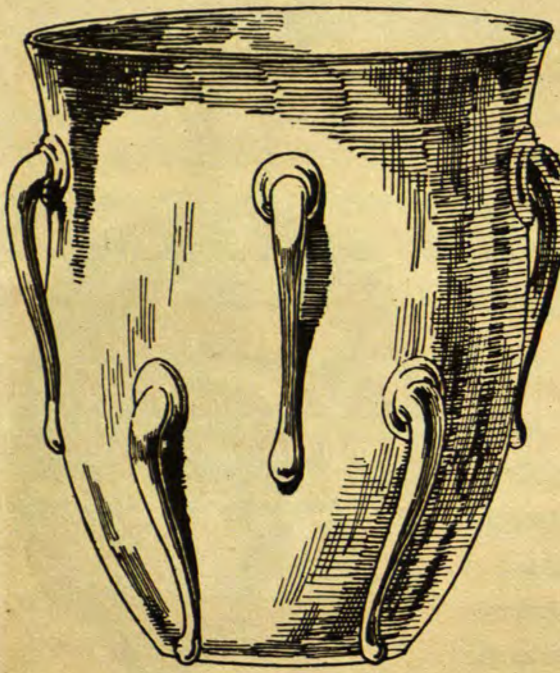
The so-called Pompej Haematinon (a blood-red glass beaker) was chemically tested by Pettenkoffer and this is his analysis: 49.9% quartz; 11.54% soda; 7.2% potassium; 0.87% magnesium oxide; 15.51% lead oxide; 11.03% copper oxide; 2.1% iron oxide with traces of manganous oxide; and 1.2% alumina.

Pliny described (XXXVI—26) how one gained magnificent obsidian glass: Hard and soft wood was used, soda and copper, and these were melted without interruption like metal. The first product was dark red. Pettenkoffer has produced an exact obsidian glass by following this recipe. He even managed to carry out the transition from the black to the red colour. The Romans knew how to give glass a metal sheen. It was not identical with that found in old glasses after they had been buried in the earth for hundreds of years. This we call "incandescence". The Romans added a certain resin to the salts and made their glasses iridescent "golden" by the use of silver, and "blue" by the use of bismuth. Franchet asserts that he gained similar results with Roman recipes.

An interesting detail: the Murrinian beaker did not come to Rome directly from Egypt, as had been asserted hitherto. It was brought from Pompej where it had belonged to the legendary treasure of Mithradates. It was said to have been made of white glass sprinkled with red. The opaqueness was achieved by the use of bone chalk. It was strongly opalescent. In this rested its value. Throughout history technical literature is crowded with such details; it would be senseless to repeat them here.

Finally, mention should be made of one of the things which are used to reproach Pliny for his credulity:

In volume XXXVI—66 he speaks of an unbreakable, flexible glass whose inventor had shown a piece to Emperor Tiberius. It is said that the Emperor had the workshop of the inventor pulled down to prevent a catastrophic devaluation of glass and precious metals. Petronius, too, tells of an Emperor who had a man beheaded for asserting that he had produced an unbreakable glass vessel. These reports



30. Roman beaker with fired decorations of prolonged glass tears. Reproduced from A. Kisa, vol. I.

can not be proved today: chemists, however, claim that it might have been the case of a resin-like artificial material; but even this lacks all positive basis.

Mirrors

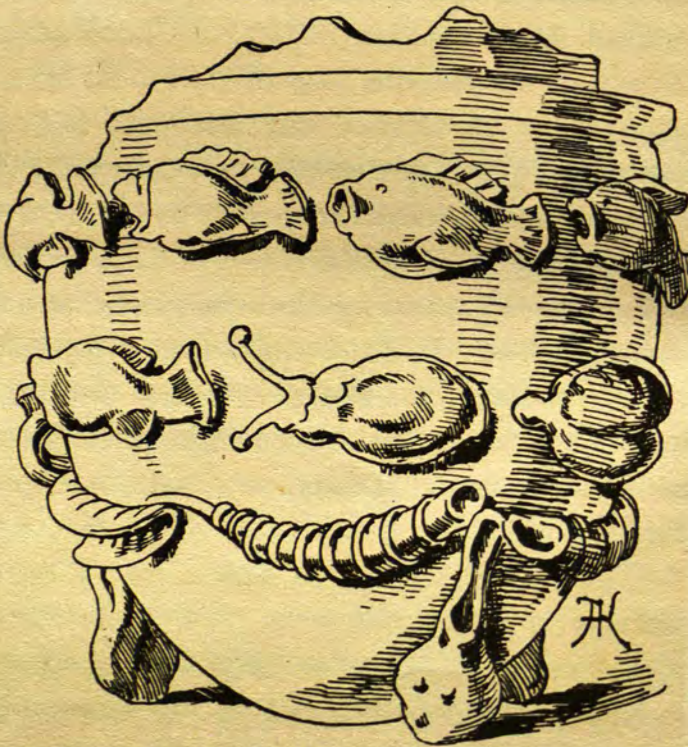
In Antiquity the problem of mirrors was connected with the polishing of the surface and the metal covering. In actual fact some fragments of blind or blackened mirrors have been found at Regensburg and elsewhere. Usually leaves of gold, silver, tin or copper were placed between two layers of glass. But excavations show that the glass was not polished as today and therefore it grossly distorted pictures. Near Rheims and in other parts of France glass fragments from the third or fourth century after Christ have been found — in size resembling a watch glass which at the bottom had been covered with lead. Since these fragments are part of a larger, round receptacle they were not absolutely flat. But Antiquity did not know either convex or concave lenses. Only Pliny relates of Nero that he had watched a gladiator's fight through a cut emerald, apparently because he was short-sighted.

We know, moreover, that wooden ships were set on fire by means of lenses or mirrors. In different places glass lenses were found which served as belt decorations. In Carthage the façades of villas were decorated with them, so that the powerful African sun might make them shine like precious stones. Here it must have been the question of the same glass which was used in the Middle Ages as window glass.

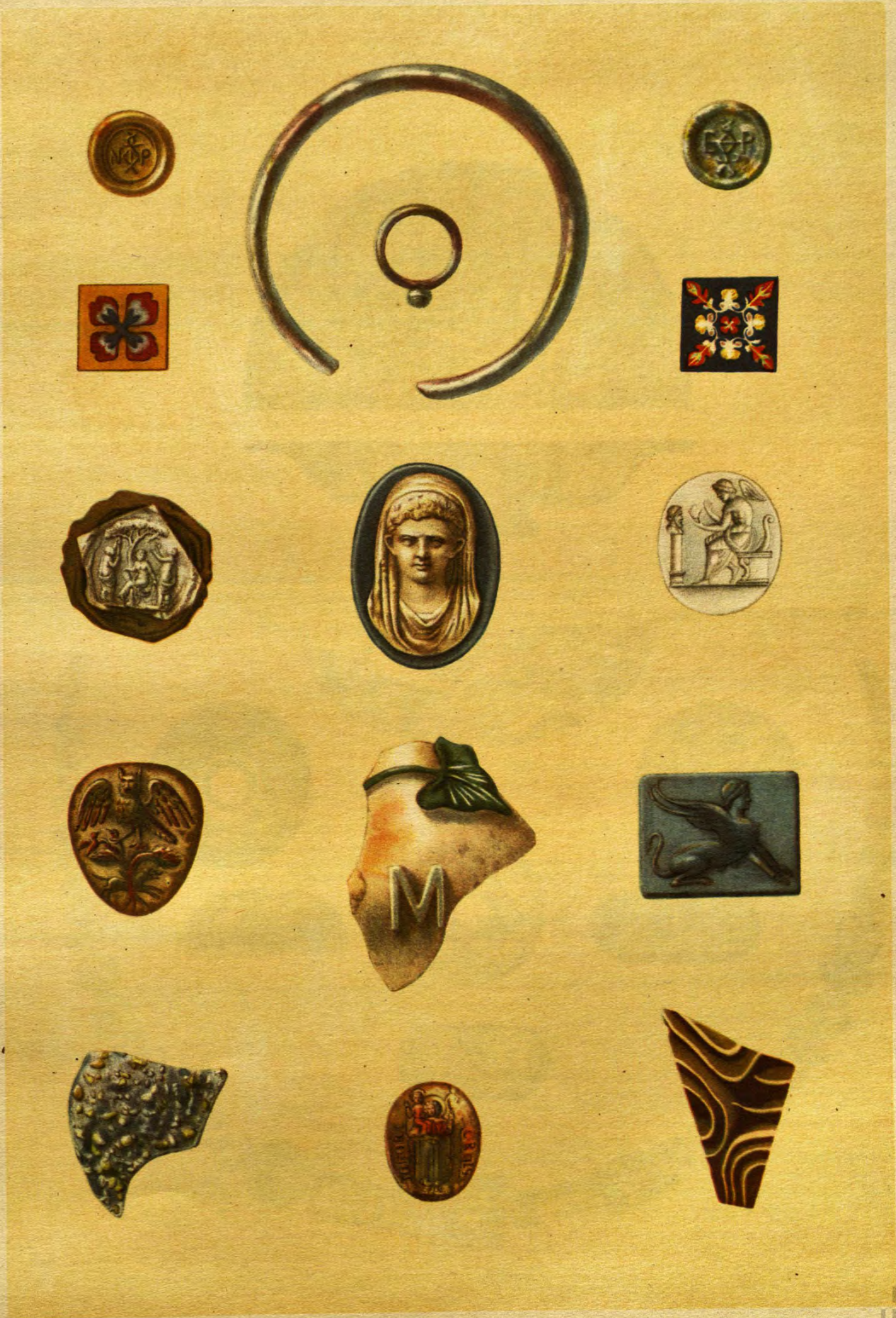
Jewelry

It is necessary to point out that the Egyptian bijoutery manufacture made artificial precious stones. In the tombs of the pharaohs we found, side by side with real gems, also imitation stones; at that time there were no physical or chemical tests and any deals were made with the same uncertainty as picture sales before the discovery of X-rays. In Rome too, Seneca reports, there were entire factories set aside for the production of glass bijoutery. Whereas the Egyptians limited themselves to impressing a coloured frit into porous stones the Romans discovered lead glass and used its high reflections to make bold imitations of real diamonds.

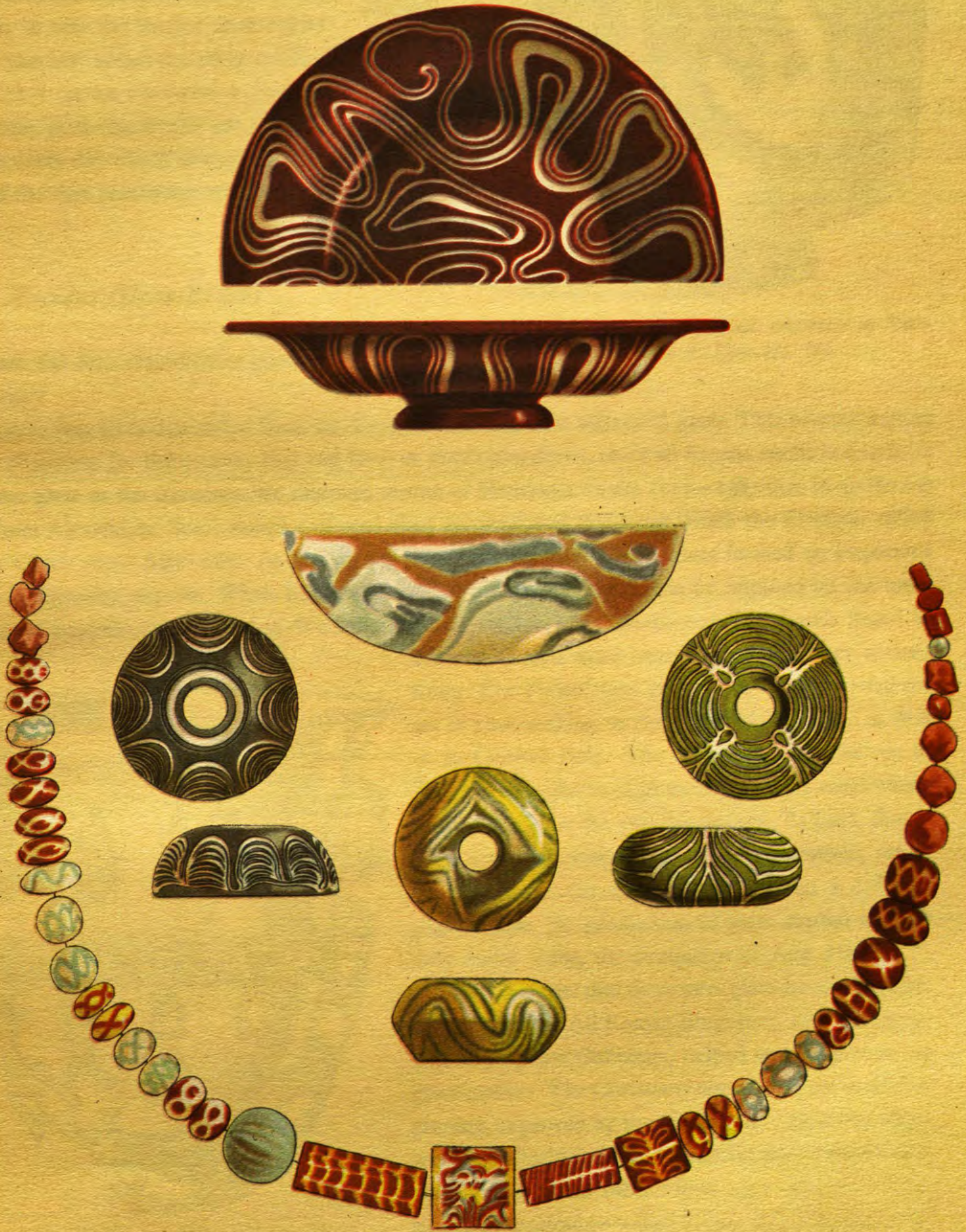
This is a circumstance which proves fairly



31. Roman glass beaker, with adhering sea animals. Reproduced from A. Kisa, vol. III.



COLOUR PLATE XI



COLOUR PLATE XII

distinctly that it is nothing new to deceive men in this way. Rhodopulos has shown that already as early as the Mycean period false beads were made by melting of lime, manganese and silicic acids. That upsets all theories, and therefore it would be best to wait for further excavations which the new socialist society enables us to carry out on a hitherto unimaginable scale. New discoveries are coming to light every day which change the picture of the dim past of our countries.

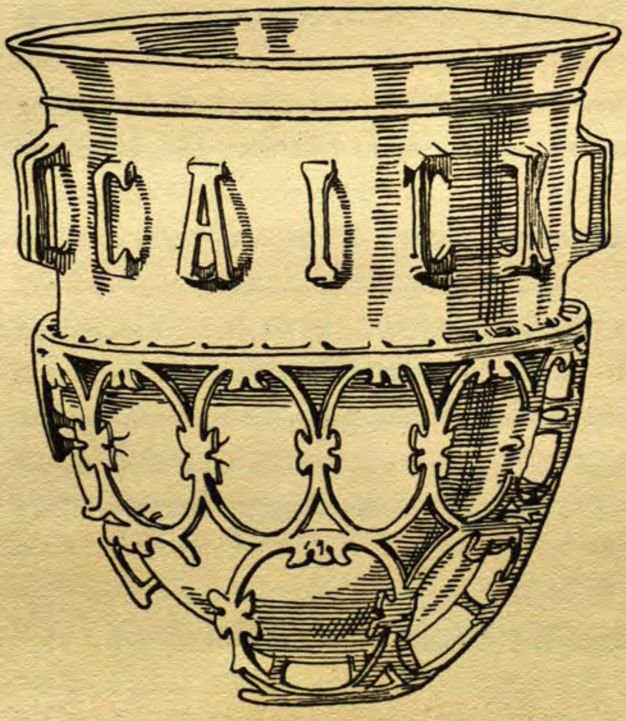
32. *"Animal fight" painted on a Roman bowl, excavated in Scandinavia. Reproduced from A. Kisa, vol. III.*

Ancient Glass-houses

Where did they manufacture glass in Antiquity?

Emperor Augustus demanded from the Egyptians part of their tribute in glass. This became a great source of income for the country that had been so much plundered, since all Roman snobs had to have the same glass as the Emperor. We discover in one of Hadrian's letters (117—138) that he preferred glass from Alexandria. Some samples of opal glass accompanied this letter which the Emperor called by the Greek word Allasontas. As late as the third century after Christ glass formed an important article in Egyptian exports. When Emperor Aurelius conquered Alexandria he imposed on the town a tribute of papyrus, linen and glass. We know that Assyria, too, had glass-houses. The vessels found in Nimrod's castle must have originated in very ancient times. The Phoenicians and the Egyptians carried the art of glass-making to the Greek Archipelago as well as to Central Italy. The excavations carried out in Toscana brought to light multi-coloured vases which might belong to the pre-Roman era. At least, that is Jules Labarte's assumption. Others, however, are of the opinion — the same author says on a different page — that the production of glass started in Italy only under Sulla, the conqueror of Asia Minor.

Today it is sure that there were glass-houses in Rome under Tiberius. All Roman Emperors, with the exception of Emperor Gallianus, helped and supported the glass-makers. The Christians also used glass at the beginning, as proved by the finds in the catacombs. They were apparently the first who inlaid their beakers with gold leaf on which Bible verses were written — these, similar to the double-walled glasses of the Rococo time, were once again covered with a layer of glass.



33. *Net glass, or Roman "Vas Diatretum" from Cologne. Reproduced from A. Kisa, vol. II.*

Another trustworthy source says that Persia and the whole of the Asian coast covered their demand by imports from Egypt. The existence of glass-houses in Asia Minor can be proved only at the time of the Roman Emperors. The Syrian glass-houses served until the twelfth century.

South Italian glass-makers set up branches in Spain (Tarraca). Already in the first century after Christ the art of glass-making was carried into Gaul and found favourable conditions there, so that in regard to quality and quantity they soon put the mother country into the shade. Also in England there was glass production from roughly the first century after Christ. From Gaul it spread to Trier and the Roman Rhine district.

History repeats itself; hardly three hundred years later Gaul was outdone by Cologne, the centre of the Rhine district. Apart from Cologne the names of Trier, Worms, and some smaller places along the Eifel are mentioned as well as Boulogne, Amiens, Reims, Vermond and Namur in Gaul.

Doubtlessly, glass was being produced also in those countries that had not been conquered by Rome, e. g. in Bohemia; but it does not seem to have rivalled the Romans in quality, who attained perhaps the climax of glass-making of all times and countries.

In the fifth century glass-making was on the decline which must be stated with greatest regret. The beginning of the great tribal migrations forced European glass-making back to its lowest stage. The only glass that showed any further development in Western Europe was the green, impure "forest glass" that was produced in a very primitive fashion.

Fortunately the Eastern glass-houses suffered less from all these upheavals; they continued to function, saving thereby the basic secrets of the technology of glass-making. These were later adopted by the Venetians and finally also by our glass makers, of course, under utterly different economic and social conditions.

Later we shall see how glass-making spread in the East until it reached China in the third century.

Ancient Glass-Engraving

The first art of embellishment which Antiquity adopted was engraving. For this a cutting wheel was used. Apart from the fact that the lead wheel has been replaced by a copper wheel nothing has been altered on this instrument to this day. The Egyptians used even oil mixed with emery. Although they knew the unsurpassed hardness of the diamond they did not employ it in glass-making. From simple dots and lines they gradually passed to more complicated designs and finally even dared to create human and animal figures. Artists in the Rhine valley produced masterly work during the Roman period when the advantages of deep intaglio had already been recognized and when they created their pictures almost plastically. In order to increase the impression of their work they took to cutting.

34. Roman bottle of green glass decorated with snake-like coloured glass threads. Reproduced from F. Slade.

Ancient Glass-Cutters

The peak of ancient glass-cutting — rarely reached even today and certainly not surpassed — is formed by glasses with a cut relief covered by a layer of differently coloured glass. This highly artistic technique was already known in Egypt at the beginning of our era, especially in Alexandria. Vessels of this kind were made in such a way that a coating of white, opaque tin glass — roughly 5 mm thick — was superimposed on a dark-blue or brown vessel. This coating was consequently removed, at least partially, by a cut relief so that the differently coloured under-layer was allowed to be visible through the top layer. This further increased the impression of plasticity. The thinner the white upper-layer was, the clearer did the dark background shine through it and the finer and more effective were the colour hues. Frequently such dark glass was given a double layer of glass.

We have a few pieces from the time of the late third and early fourth centuries after Christ, of which the so-called Lykurgos beaker is the most representative. While still in a liquid state, plastic figures and whole scenes were attached to these vessels made of magnificent deep colours. Many of them are quite loose, having been attached to the foundation only by admirably thin and daring connecting-rods. These "stuck on" ornaments were, moreover, decorated with engravings.

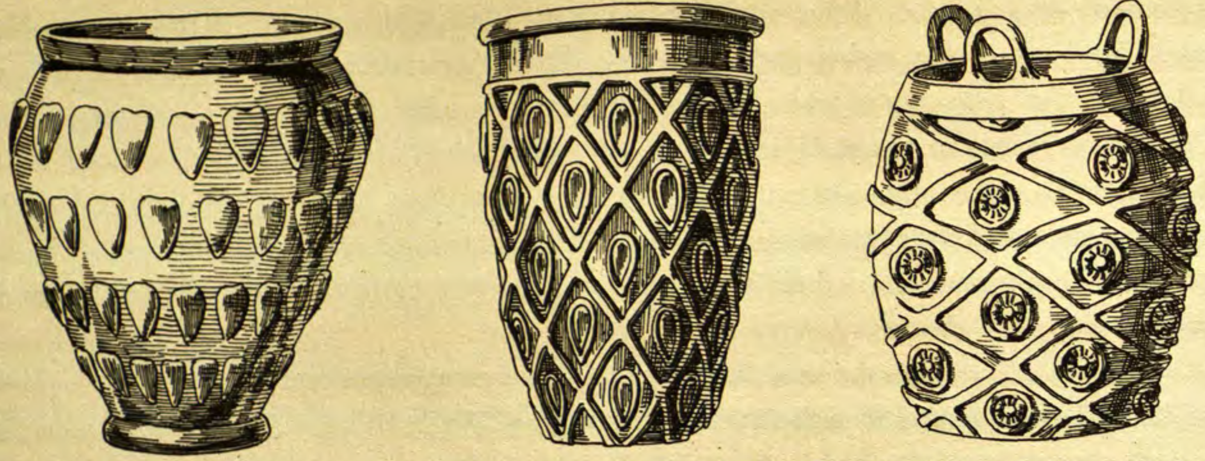
The Diatreton Vase

By producing the so-called "Net Goblets" Antiquity acquired the technique of refining — a technique which of all those invented and executed may be the most protracted, delicate and complicated. The process of refining glass here reached its climax; it even surpassed the limits of what we can achieve with our experiences in production. In the Bonn Almanach, volume 74, p. 176 and the magazine "Sprechsaal" from the year 1881, numbers 1—4, there is a report of the experiments of a Bavarian glassworks manager who succeeded in producing a few copies of these "net glasses". One of them was exhibited in the glass exhibition in Nuremberg in 1884 and sold for the price of 500 Marks. But even the most experienced workers do not now dare such things, even though from a technical point of view they tower far above the Romans.

What actually was the problem here? The surface of a particularly thick receptacle was cut until only a thin core remained, or rather, it was reticulated until a sort of net remained. With a small wheel this was worked until the entire vessel was covered with an extremely fine lattice which seemed suspended over the newly created lower surface and was connected with it at a distance of 3 mm by only thin glass pegs.

It is assumed that all these "net goblets" originated roughly at the beginning of our era in one glass-house in the Rhine valley. Most of those damaged samples that have been found consist of colourless glass; only a few have a coating of colour. Of course, not all "net glasses" arose in such a laborious fashion. The process was simpler if the vessel was covered with these thin pegs which were fused to it until it resembled a gooseberry. Another thin-walled receptacle of a similar form but somewhat larger was separately made and with a grinding wheel it was cut to a net which then in the viscous stage was fixed onto these pegs on the inner vessel. Yet a third process is known which nowadays cannot delude us:

35. Bottle with decorations from the Barbotinglass-house in the Rhine Valley. Reproduced from A. Kisa, vol. I.



36. Three Roman glass beakers with fired decorations of coloured glass. Reproduced from A. Kisa, vol. I.

on to these thorn-like pegs a small net of glass threads was attached — but that is no longer a work of art, but mass production. (See Explanations for the latest theory on the Diatreton Vases.)

Cutting

Grinding and cutting of glass were already as popular as engraving during the first centuries after Christ. The difference between these two manners of embellishment depends merely on the size of the grinding wheel. This technique too has maintained itself almost unchanged to our days, and when one considers that the driving force both of the old Romans and the nineteenth century glass-workers was only water power, one cannot really speak of progress.

Whereas in engraving the decorations remained dull, they were given a fine gloss by polishing on wooden disks.

Fortunately a number of cut glass vessels have been preserved, mainly in the Rhineland tombs; ranging from simple patterns to quite modern, extremely tasteful designs, they bear witness of the high standard of art of these old glass-cutters. Especially popular were the flat or the flaked cuts which covered the entire surface of the vessel.

A Few Preliminary Words About Painting and Gilding

Glass painting is a very old art which originated in Egypt. The vessels were coloured with natural dyes which were attached with varnish, and also in the way which today we call the cold method of painting. In Rome also enamel colours were used which could be baked and added durability to the glass.

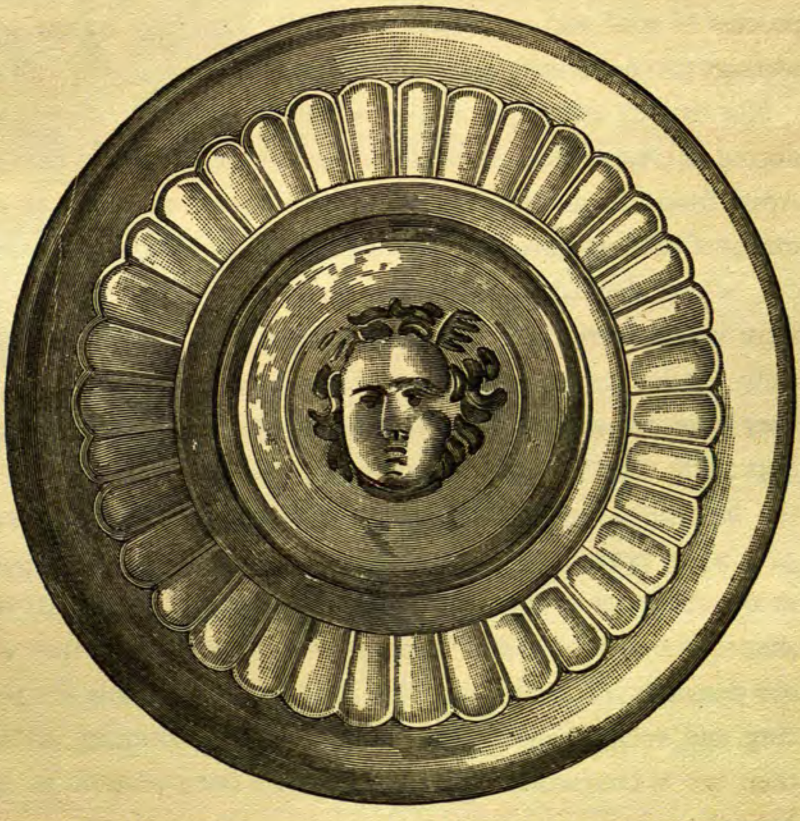
These enamels made from finely powdered, easily melting glass mixtures, were dissolved in a cement and put on with a brush. Antiquity did not know blue stains about which we shall have more to say in the chapter on Egermann. Engraved glasses were often either painted or gilded. The pictures that had been engraved were stressed by the use of gold leaf. It is interesting that most of the finds originated from northern countries. Circus and hunting scenes were particularly popular. Painted Syrian vases have been found which give the impression that they were made in the last few decades, not two thousand years ago. In the catacombs of the Roman Christians glass vessels have been discovered — mainly dishes — whose flat double bottom was decorated with scenes in gold leaf.

The Shapes of Old Glasses

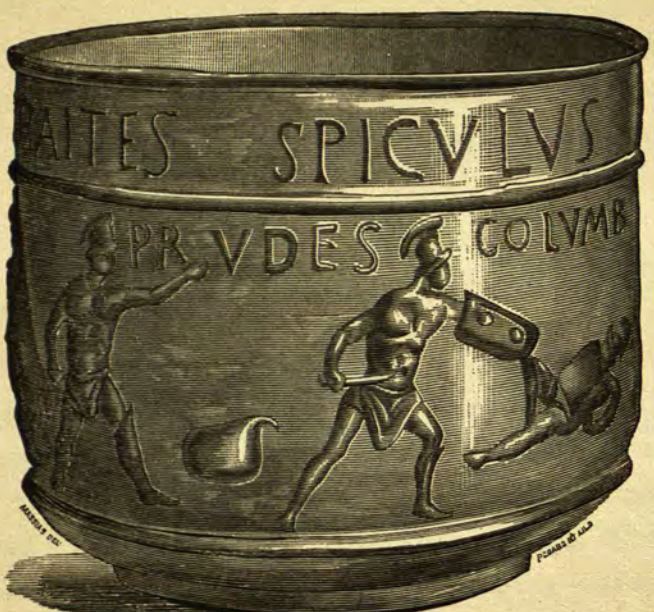
By learning to make glass containers on a copper spindle or around an earthenware core pre-historic man merely copied the forms of the ceramic or metal products that existed at the time. Shapes that suited metal articles soon disappeared, but until the introduction of the blowpipe no other patterns existed in glass-making than those of pottery. It was only the technique of working the hot viscous glass that was victorious over the shapes which had traditionally been made on the old potter's wheel. The closer the glass-maker of Antiquity approached his ideal — the production of crystal-clear, translucent vessels — the thinner and the lighter could his precious produce be.

Apart from the close imitations of ceramic goods many other shapes were developed at that time, which — since their purpose and beauty corresponds more closely to their production technique — have held their place to this day. Most of the ancient glass vessels were naturally found in old tombs. We are endebted to the custom of giving the dead precious gifts on their journey to the other world; for in this way we know most of the shapes of the ancient products. Else this fragile glass could hardly have survived to our days in such quantities and as such complete collections. Else only a few isolated precious pieces, hidden in churches and monasteries, would have survived the whirl of history.

The overwhelming majority of the old glass is in bottle shape. There was an almost infinite variety of different bottles, all tasteful and interesting: neat unguent jars, small dropping bottles, consecrated to funeral services, long-necked bottles, delicate perfume bottles and cream jars; all the slave-owning class that used cosmetics to an absurd degree employed these in large quantities. Large decorative bottles were used for transport and vessels shaped like vases, with and without handles, for the storing of liquids. No less admirable are also the small jugs with spouts and handles whose classical forms rouse our enthusiasm. An important place must further be reserved for drinking vessels. There are beakers, funnel-shaped vessels with and without handles, goblets and delicate chalices as well as drinking horns. All have interesting and purposeful shapes. There are also a number of plates and bowls which were frequently made of glass. Nor may we forget the urns used as receptacles for the ashes



37. *Roman cut-glass cup with the relief head of Medusa embossed on the bottom. Reproduced from A. Kisa, vol. II.*



38. Roman glass bowl with bas-relief, portraying a gladiator's fight in the circus. Reproduced from W. Froehner.

of the dead which were placed in clay or lead containers. And finally there are the manifold objects of glass in the shapes of hammers or funnels, animals or birds.

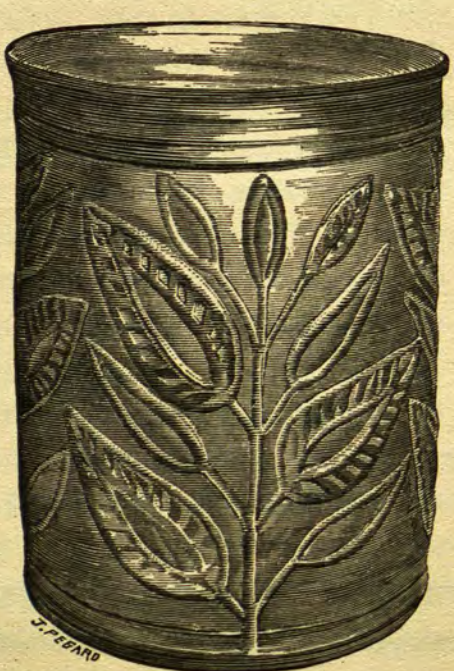
And the Lesson of All This . . .

Only few people today are aware of the basic and important significance of this review of the ancient art of glass-making, the development of technique and growing experiences. For today, it is not a question of discussion for archeologists — whether the two half naked men found on the almost 4 000 years old sculpture in the Egyptian settlement of Beni Hassan were, in fact, glassmakers with blowpipes or — as Egyptologists of today assert — smiths bellowing their hearth. Even the discovery that glass was being made in the dim ages would not be so decisive for our society and particularly for the glass-makers, if this ancient product had not set an example and the direction during the following 1 600 years, having brought forth and trained ever new generations of glassmakers.

It is extremely important to clarify these basic facts: The character of the viscous mass has hardly changed since the discovery of glass. By far the greatest number of the different mixtures was already known in Antiquity. All mixtures as well as the use of decolorization and colouring followed the process of trial and error until recently. For only in the last few decades have chemical research workers given scientific precision to glass-making.

Nor has the technique of glass-blowing undergone any changes during the two milleniums since the discovery of the blowpipe. Apart from the sand blast grinding, etching and mordants, no other means of refining have been introduced. On the contrary, the panelcut, which thrived in Antiquity, and the "Millefiori" technique were re-discovered only in modern days. And even though especially skilled artists have reached the same technical perfection, they have not succeeded in surpassing the patterns of Antiquity. Especially the "net glasses" remain mere exceptions. Soon after the first introduction of the glass blowpipe the old glass-makers gave some personal shape to hollow glassware that corresponded to the character of the blown glass. Therefore the majority of the shapes of that time is still being produced today, since they satisfy our demands for usefulness. Nor have the implements for producing and refining glass been changed since Antiquity, so far as their use is concerned. They have merely been adapted to engine power.

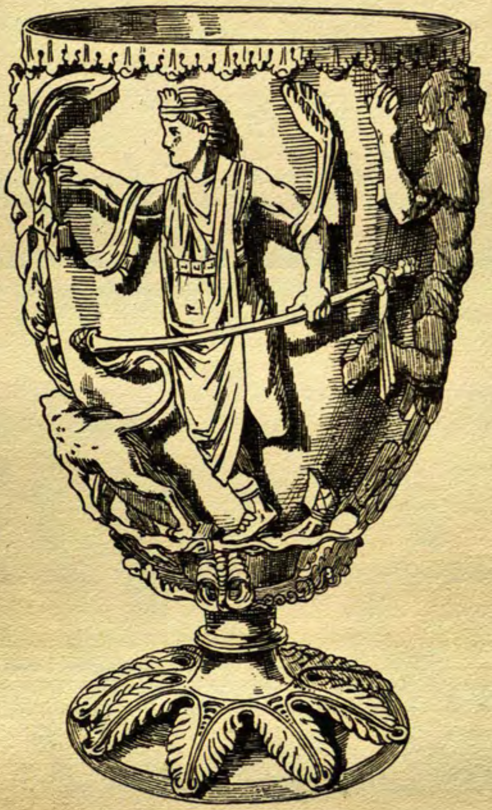
When we ponder a while on these basic conceptions we must



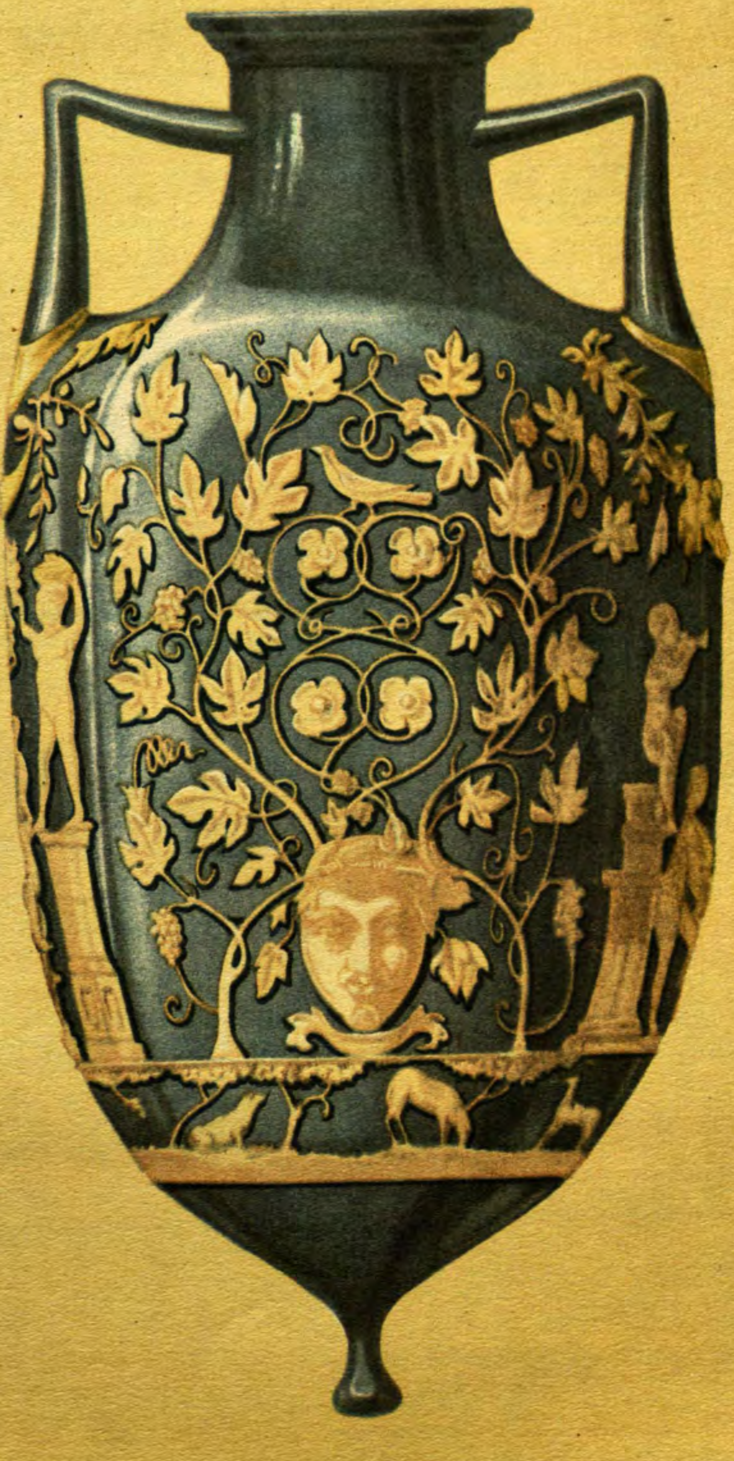
39. Roman glass with magnificent cut relief of leaves. Reproduced from W. Froehner.

reach the conclusion that since the beginning of glass-making the skill and dexterity of the worker and his artistic feeling have been the most important factor. The implements, on the other hand, hold a second position. Of course, in modern times there is now a glass industry which has become partially or entirely automatic by the use of machines, but not even that has changed the two thousand year old work principles.

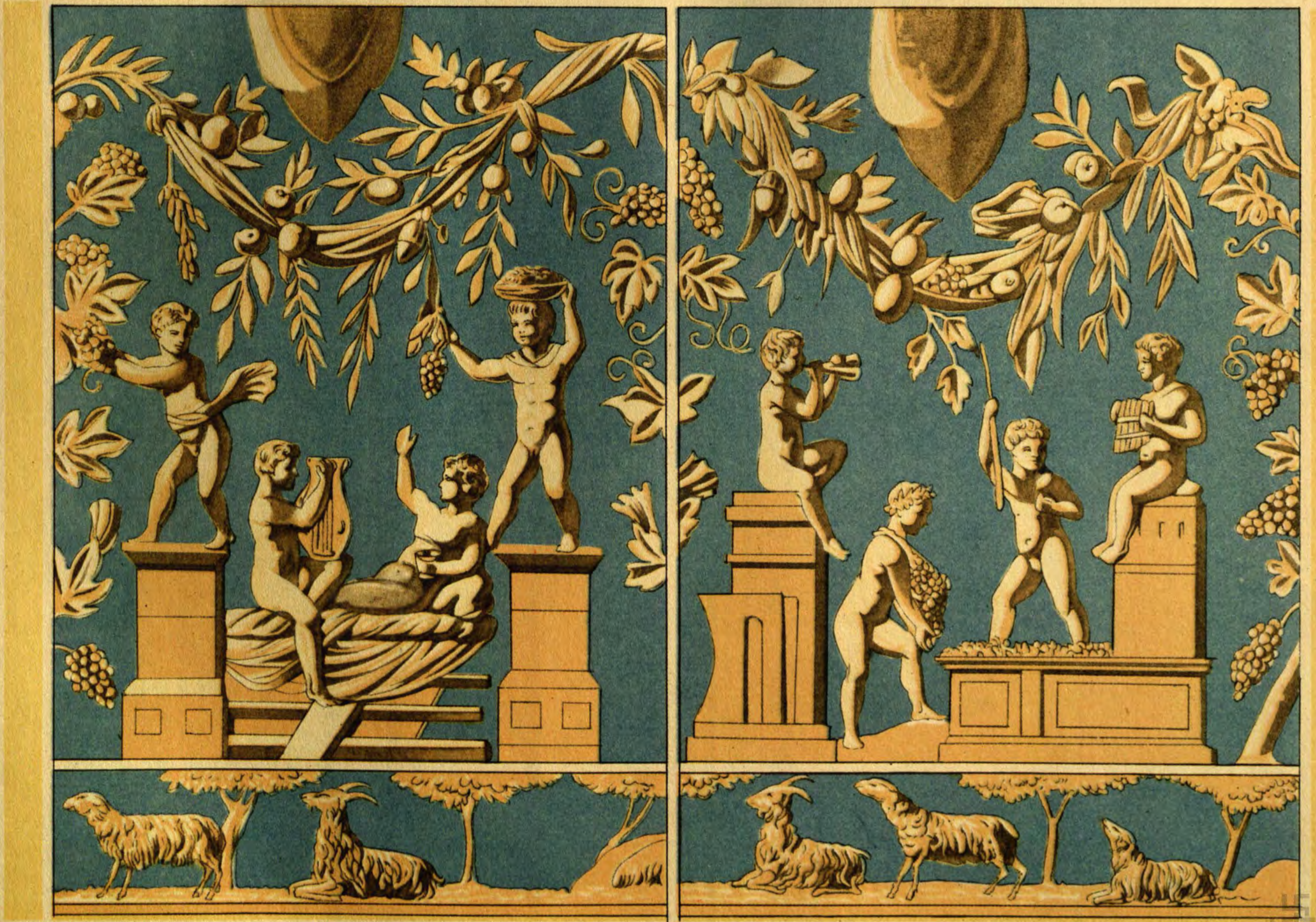
It is proper to apply the Marxist-Leninist teaching here to show why we may turn—in thought—to a time where around 1 900 the collectives of workers in the Bohemian capitalist glass-works were forced to create under almost identical social conditions that seem to have existed in the glass-workers guilds in Rome. These conditions were hardly improved during the long Middle Ages; only gradually, with the growing demand for human rights and freedoms did conditions take a turn for the better, only to succumb once again to a new and worse yoke: capitalist exploitation.



40. The famous "Lycurgos Goblet". Reproduced from A. Kisa, vol. II.



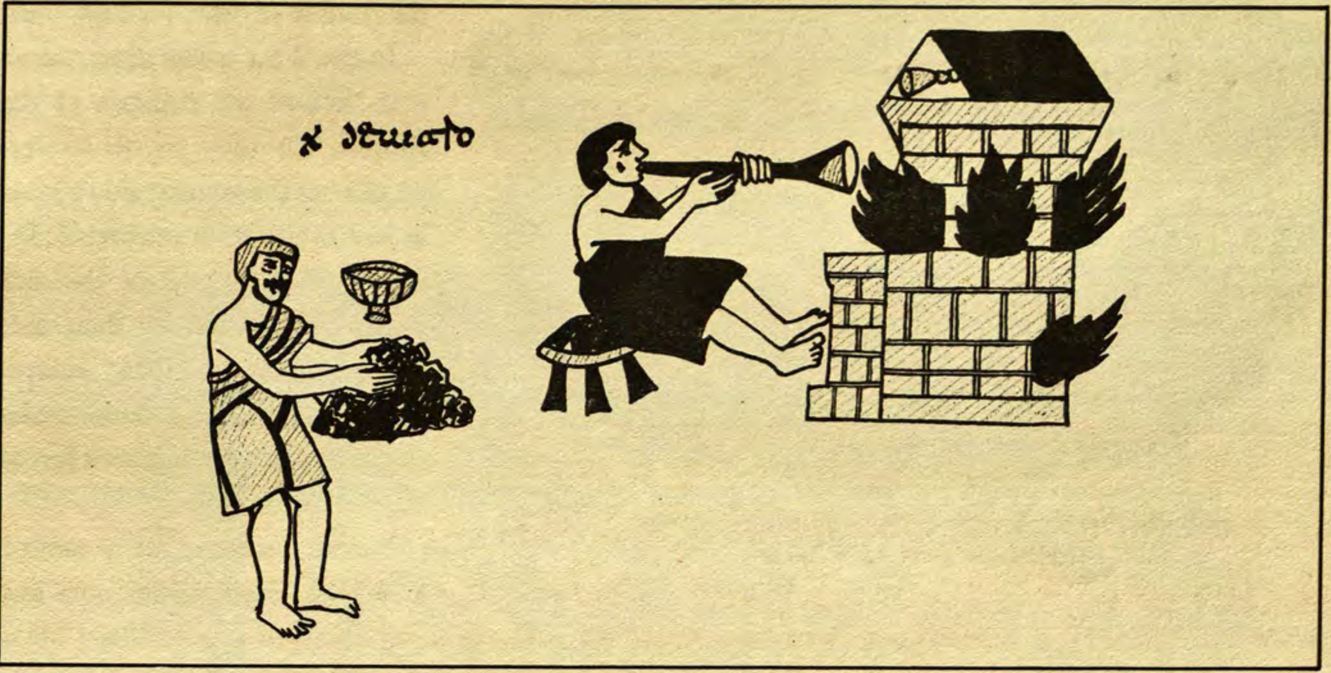
COLOUR PLATE XIII



COLOUR PLATE XIV

II

THE MIDDLE AGES



41. Early Medieval furnace: To the left, a glass-maker is squatting, cleaning the broken frit. To the right, the master glass-maker is sitting, blowpipe in the furnace . . . Taken from the work by Rabanus Maurus (Bishop of Mainz; died 856): "Beati Rabani Mauri de universo libri XXII" lib. XVII.

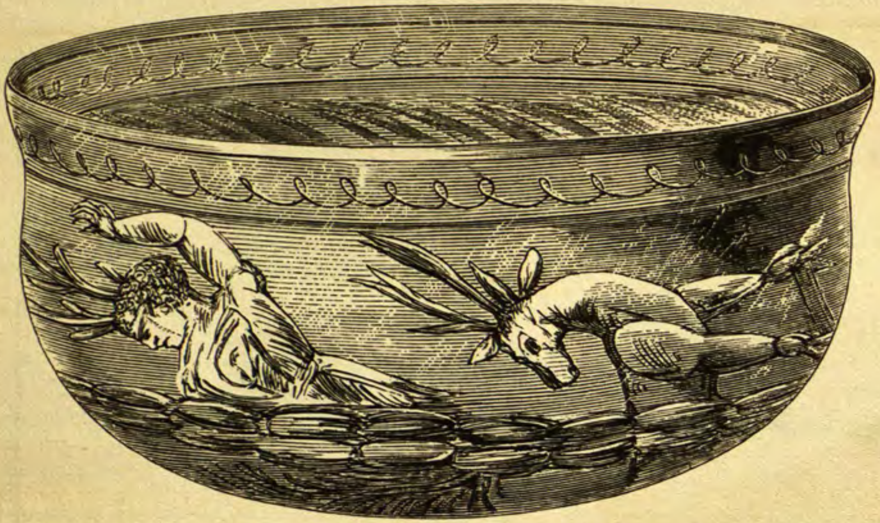
THE EARLY MIDDLE AGES HALVED THE WORLD

ROME FELL AS THE RESULT of the class warfare that raged between the rich and the poor, the exploiters and the exploited, those who enjoyed full rights and those who lacked these. These growing contradictions weakened Rome, having long knocked on its brazen gates. There Rome lay, like a valley after the burst of the dam, flooded by tribes who were eager for revenge and loot; those very barbarians whom for a long period it had incited to mutual enmity and had alternatively weakened, suppressed and sold.

E. A. Kosminsky relates how the Roman social order, based on slavery, was undermined by the resurrections in the colonies and by the attacks of the barbarians. He explains the organization of the barbarians and gives the reason why the exploited free peasants and slaves submitted rather to the new usurpers:

"The new lords made no great demands after the disappearance of town life and the decay of trade. They were satisfied with a simple life in the country. Therefore they did not exploit the slaves and the free peasants so cruelly as the Roman estate owners. Most of the slaves were granted some land, and together with the free peasants they formed the class of serf peasants. The great latifundiae fell to the king . . ."

Byzantium, the East Roman Empire, followed the same path as the Old Empire. The population was no less exploited than in Rome, so that for a short time the neighbouring New Persian Empire surpassed the entire Christian world with its better means of production and higher culture. But Persia just as the East Roman Empire finally succumbed to the Islam, the fanatic attack of the desert dwellers, who were covetous of winning the means of production of the existing civilization. For this purpose they availed themselves of the extreme exhaustion and deep decay of both the Empires,



42. Magnificent Byzantine dish, painted with enamel. Reproduced from Felix Slade.

the result of the endless wars.

In the West towns disappeared even before the collapse of the Empire. The town people scattered all over the countryside where, as late as the sixth century A. D., slaves tilled the soil of the rich estate owners, but by their side in the villages a new subject people were settling down under the new rulers, having been forced to start work again.

People returned to a natural economy. High productivity and trade that relied on a large empire were suspended; the gold coin, expedient of a centralized state, disappeared. The feudal manor produced for itself everything that was needed by its miniature world. This applied to the Franks (where the crystallization of the new society and the new state power arose first) as well as to the Germans, Teutons, or Slavs. That, in rough outline, are the conditions in which mankind passed the one thousand year long epoch of the Middle Ages.

This is no place for a detailed explanation of its unequal, uneven and therefore immensely complicated development. Only a few outstanding events will be mentioned that essentially illuminate the contradictions which caused the changes in the means of production; — these changes, being conditioned everywhere by evolution, apply also to the medieval glass industry.

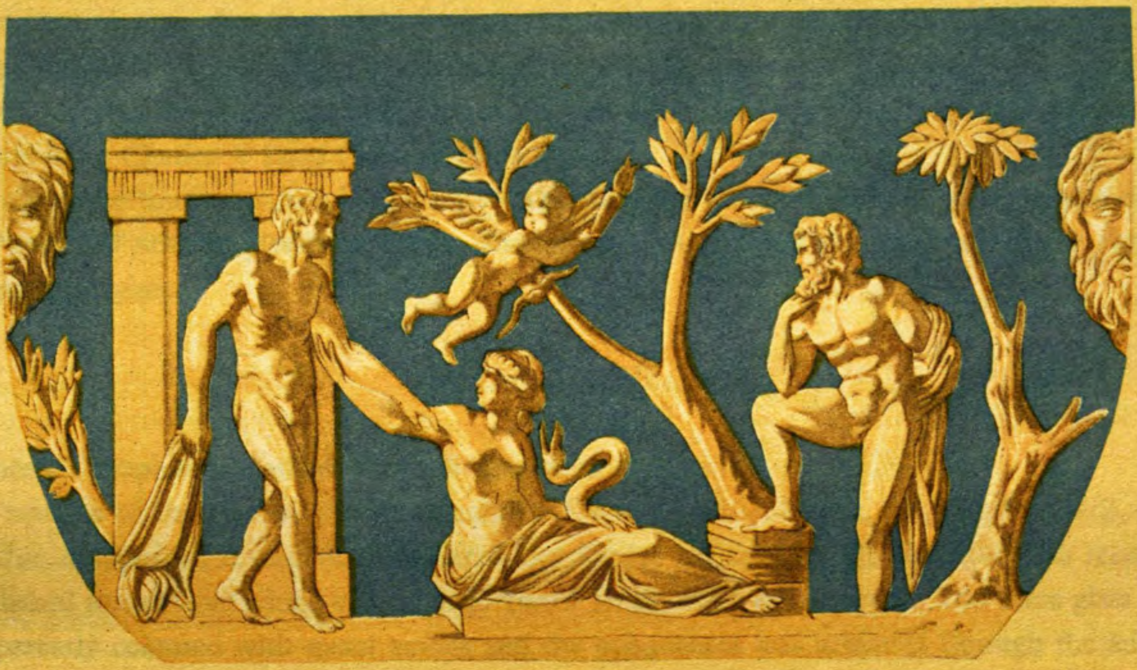
The Orient — the Refuge of Glass-Makers during the Great Flood

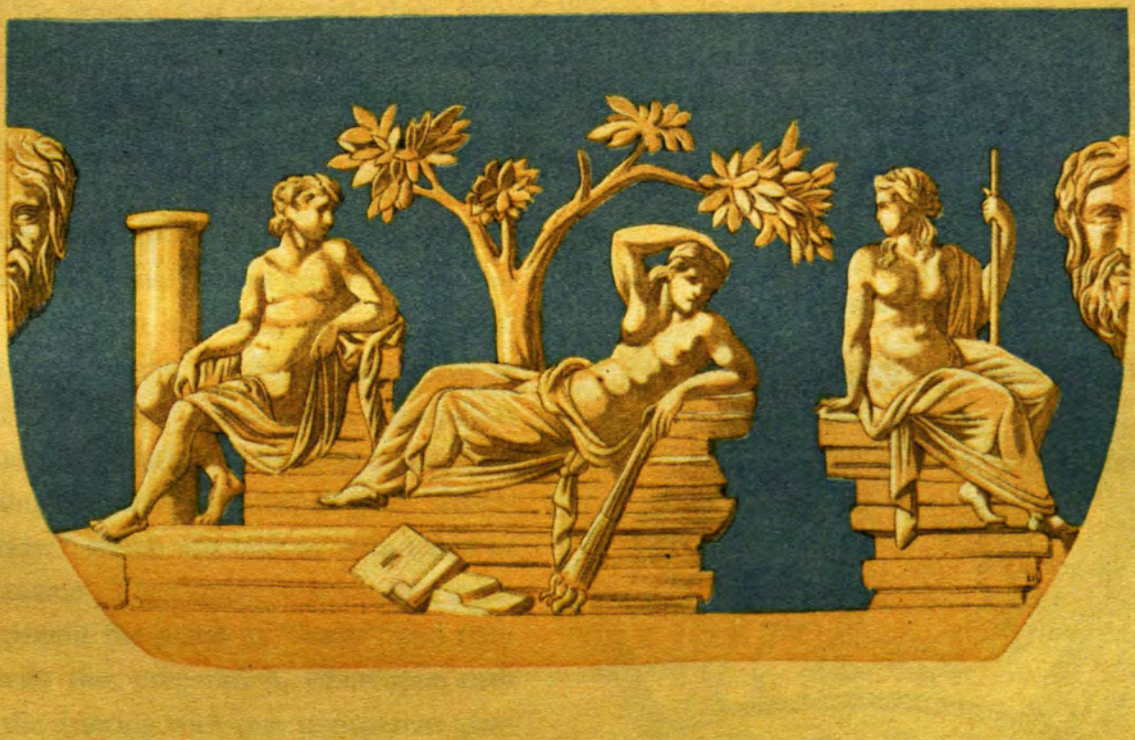
When Constantine the Great changed his place of residence to Byzantium he surrounded himself with famous artists of the Roman Empire. Western glass-makers too responded to his call. They, who claimed to know almost all the secrets of production and refining, settled under the wings of a monarch who was willing and able to give them protection. At that time that was someting undreamt-of in Western Europe.

The new glass-houses grew up not far from the harbour in "Constantine Town" — Constantinople, so as to be close to the then essential water transport. The Emperor had made no empty promises. Theodosius' statute book confirmed them when it guaranteed the position of these important craftsmen. It remitted all taxes imposed on glass-makers and granted them really great privileges — quite unheard-of at the time.

This generosity on the part of the Emperor proved soon a very far-sighted move. After but a brief period Byzantine glass ranked second to precious stones in Western Europe. It became the pride of the rich and mighty to own a collection of such glass. From an economic point of view it was a happy move that made Constantine the patron of a craft that was sought after in the entire civilized world.

The glass-houses near the Bosporus soon set up branch works near Salonica. The famous glass-houses in Alexandria, however, and in the land of the Phoenicians — today's Syria — did not suffer as a result of this competition. On the contrary. Their reputation continued even when the Arabs ruled in





COLOUR PLATE XV

these parts. Reliable witnesses report that the Arab conquerors protected glass-making and the heirs of the old tradition. That is a further reason why throughout the long and restless Middle Ages the entire luxury glass came exclusively from the East.

A vase from Alexandria which Emperor Henry II received in 1024 shows what a high standard was maintained. He presented it to the Monastery in Cluny near Paris as a gesture which proved the high favour of the monarch.

It was at that time that the world-famous glass-houses were established at Damascus. Luxury products that reached Europe for a whole epoch "are said to have come from this town." At least so it stands written in the year 1300 in the jewel register of the Duke of Anjou and in the documents of the French King Charles V from the year 1379.

Right up to the time when the Venetians — who were the most progressive people of the time — won the secret of oriental glass production, Byzantium virtually held the monopoly in the export of this magnificent glass.

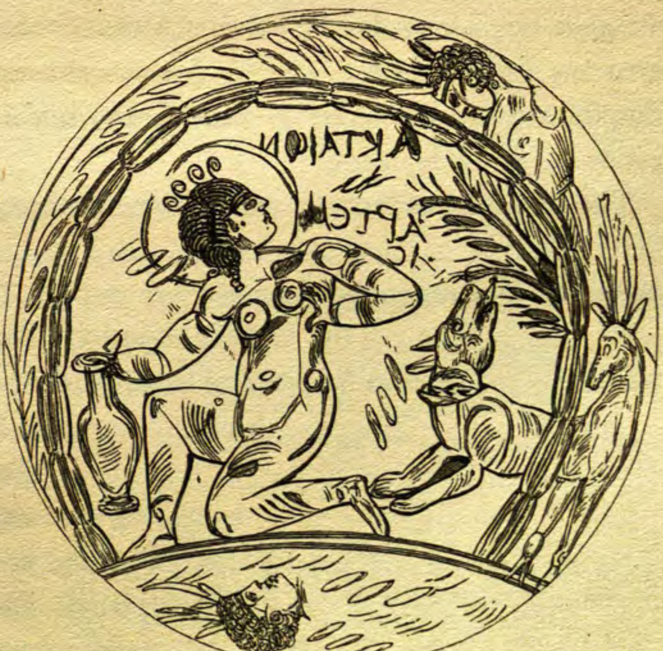
Byzantine Glass

The monk Theophilus, of whom we shall hear more later, wrote:

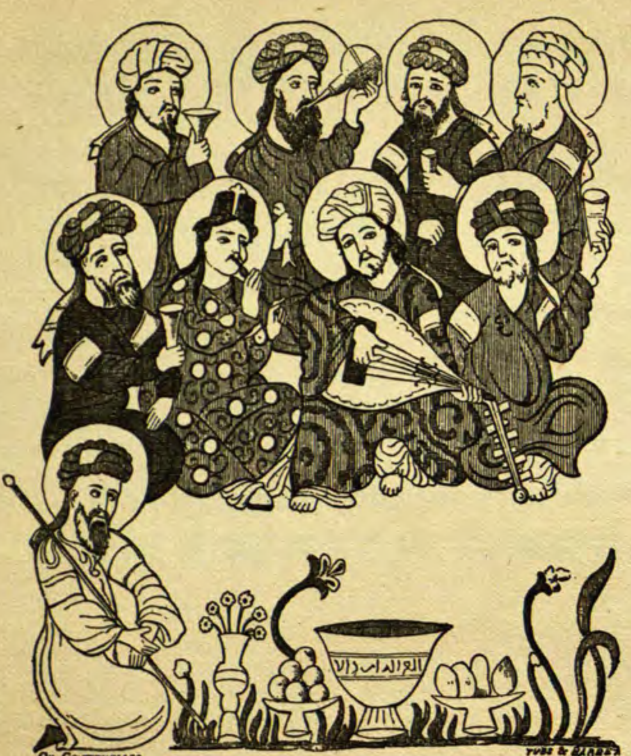
"The mosaics of the heathen houses contained different coloured glass, e. g. white, black, green, yellow, blue, red, purple. It was not transparent, but opaque like marble. The pieces of glass resembled those polished stones from which enamel is prepared for gold, silver or copper. And these glass cubes were apparently coloured with metal oxides and the opaqueness was achieved through the addition of tin oxide. The glass used during the Middle Ages for enamelling was of the same stamp."

"The Byzantine Greeks made valuable goblets from blue glass," Theophilus wrote elsewhere, but we are of the opinion that they made them also of different coloured glass and knew how to produce many other things. The clever monk described the old-Christian technique of melting gold leaf into glass. Part of his description is full of mistakes, the rest is correct.

The Byzantine method did not cover the gold leaves in overlapping layers with "perforated" glass on the blowpipe (which was supposed to be the method of the ancient glass-makers) but covered them with an easily melting enamel which was translucent, and baked everything to a pale pink. Another method which Theophilus ascribed to the Byzantine glass-makers consisted in modelling figures with the help of gold "dissolved in water" which was laid on with tongs or with an enamel. The Greeks — according to reports — ground the metal in "water" and then painted with this preparation, whereupon they fixed all the drawing with that transparent glass and finally took white, red or green glass which they used for enamelling. They then ground each sort of glass specially on the porphyry slab; when they had completed the entire picture with



43. Scheme of the same Byzantine glass painting. Taken from Slade's work.



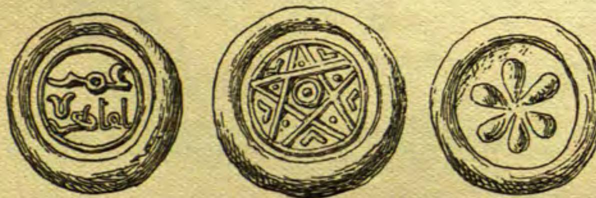
44. Miniature from the 13th century: "The Meeting of the Hariri" shows the shapes of glasses at the time. Taken from Gerspach.

the help of a colour glass solvent, they placed the vessel into the furnace. Probably gold was also dissolved in a transparent liquid that could be used for glazing. Further Theophilus says that the Greeks made vessels from transparent light sapphire and also purple glass with filigree nets of white dabs and handles of the colour of the ornaments. For the Byzantines not only knew all the secrets of the ancient glass ornamentation, they themselves discovered many new ones, especially vitrification of pigments and heat blending of glass painting. In the museum in Cluny there is a colourless glass vessel which is described as a Venetian achievement from the 15th century. But by its appearance it seems to be Byzantine glass of the 9th century, since its ornaments are amazingly similar to Constantinople mosaics of that time. In the 15th century Byzantium was already in Mohammedan hands. It is strange that in books the Byzantine cut glass is not mentioned, much of which has survived as the pictures of this books will show.

The Medieval Orient and Glass-Making

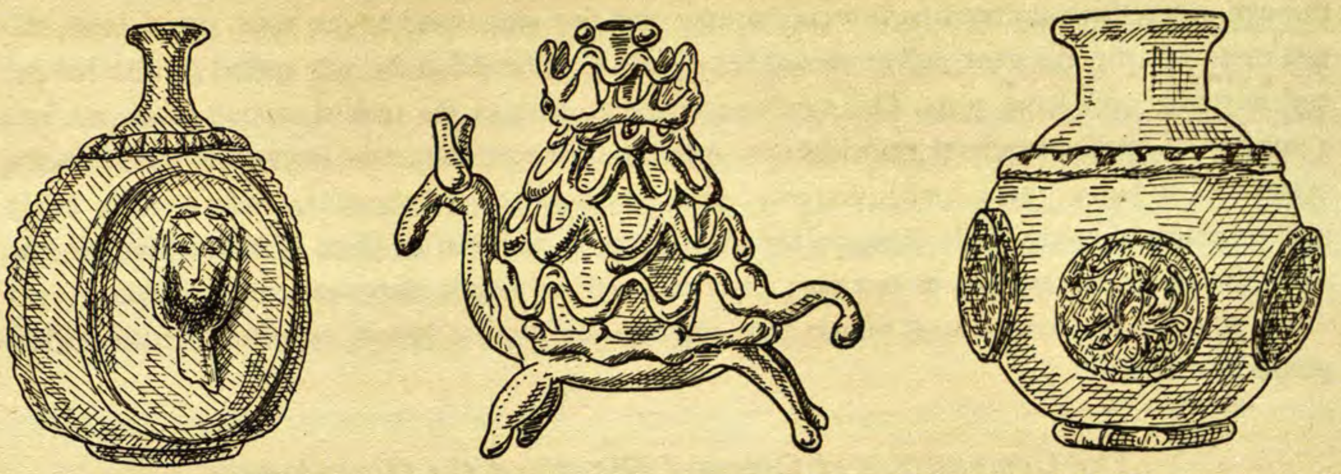
To discuss the art of glass-making in the Orient in the Middle Ages is the most difficult of tasks. Not for lack of exact and exhaustive literary sources, but because the glass-making of the early Middle Ages in the Orient represents the immediate continuation, the heir and climax of the ancient tradition. Its dependence on Antiquity being so great, it is often virtually impossible to differentiate the glass originating during the first Mohammedan centuries from the products of a pre-Islamic or even late antique period. Hereby I mean the time span that began with the fall of the Roman Empire and ended roughly in 1 000 A. D., in which glass of the classical period reached the culmination of its development.

The ancient glass industry survived the Arab occupation in the Near East and continued to thrive in the new order of the early Islamic period. The Arabs left glass-making in the hands of the old experts; moreover, they supported them in every respect. The literature of the applied arts relates with admiration that this tactic of the Arabs in regard to culture was not limited to glass. For example, the art of weaving in the Arabian Empire was almost entirely monopolized by the Christian Copts in Egypt. The goldsmiths' art lay predominantly in Jewish hands. Also wood cuts — whose tradition under the influence of the Hellenes gained fame — was carried out in the first millenium of our era almost entirely by Christian Copts.



45. Arabian glass counters. Reproduced from Gerspach.

From this early Islamic period originate the carved wooden figures of warriors in the side aisles of the Amru Mosque in old Cairo, whose faces reveal the



46. Syrian glass: First and third with embossed decorations from the fifth to seventh century A. D. The second a vessel with fired decorations. Based on C. J. Lamm, vol. II.

transition from Antiquity to the Islamic style — though not yet clearly formed at that time. To say something about the glass industry of the early Middle Ages in the Near East is so difficult because the old glass production in Syria and in Egypt is so closely related. As C. J. Lamm maintains, we are often unable to identify certain products and determine their place of origin. A similar problem is presented by hollow glass products.

Almost each glass-house formed a world of its own; to protect their interests the craftsmen formed guilds; the glass-makers' guild was a family concern with a patriarchal structure. Here the secrets of production were even more carefully hidden than in the medieval European guilds. After all, the Orient at that time "had got something" — to express it popularly — that was worth such jealous protection.

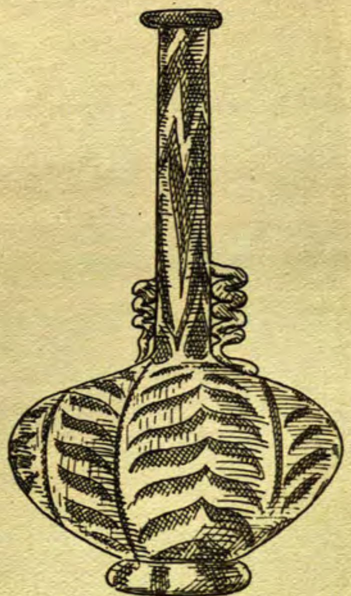
To speak of „style“ is impossible until the eleventh century — everything is simply Islamic glass and, if one may say so, independently created. The same applies to Byzantium of whose glass we know still less. A clear example: standardized weights in the shape of glass tablets, seals and rings have been found bearing the names of the first caliphs of Damascus and Bagdad as well as of the Egyptian governors. They prove to us that the ancient industry survived the Arabian occupation and continued its work in the early Islamic community.

The following event further clarifies for us the relation of the Orient with the West. It appears in a different light from what we have been taught:

The Spanish Omajade Abd-er-Rahman (about 750 A. D.) called Byzantine mosaic workers to decorate the mosque at Cordoba; hence the assertion seems correct that the great and important art of glass-making remained in the hands of the Christians.

The finds at Fustat and in Iraquian Samarra present another example: in both places beautiful "Millefiori" vases were uncovered showing a proximity of style — but the vase at Samarra comes from the ninth century and the former belongs to the pre-Islamic period.

It is interesting how the Islamic style of glass-making — at least for a time — was unified. Apart from the fact that several glass-houses



47. Bottle of combed thread glass from the 12th century. Syria. Based on the work of C. J. Lamm.

through competition imitated each others' output and that glass went to the most varied areas, the real cause was that the glass-makers moved from place to place and in this way spread their technique and dexterity over large areas. This custom stopped as soon as the unified empire broke up into a number of smaller medieval principalities. As a result the protection in large-scale manufactures ceased. As today so then, costly, decorated glass was exported and therefore we find it only rarely in their places of origin. Plain glass, on the other hand, is found in its place of production, because it is difficult to imagine that at that time unornamented and simple glass was sent far afield.

But all these conjectures must remain pure speculations. Now at last we can turn to ancient glass production itself:

The Composition of Oriental Glass and the Glass-houses

Professor Dr. Neumann of Wróclaw has chemically analysed five glass fragments found in Samarra. It became clear that he was dealing with glass produced in situ. The analysis further proved that this oriental glass contained soda, whereas potassium appears only as a by-product. For decolorization manganese was generally used and lead glass was usually cut. Thanks to these investigations we now also know that glass became opaque by the addition of tin oxide and that for colours, especially enamels, all metal oxides known to us were used, particularly oxides of copper, manganese, tin, iron and probably also cobalt. The blue enamel of the "golden, enamelled glasses" came from lapis lazuli which had been melted in glass and pulverized. Iridizing was frequently used; caused in ancient glass by long lying in the earth, this scintillation in all colours of the rainbow can be achieved by enclosing the still hot glass in a heated drum in which there is a dish of salts from the halide of any metal, such as arsenic, bismuth, barium, tin, copper, gold, silver etc. Then the mixture in the dish is raised to a high temperature and the salt vapours merge with the surface of the glass. In appearance this resembles the colour rings that form when a thin layer of fat floats on water. Mother of pearl also has a similar origin (according to F. N. Paraubek).

48. Square Persian bottle, brightly decorated with enamel painting on a blue background. Reproduced from Felix Slade.

Glass-houses such as Prof. Dr. Neumann described still exist today, according to Dillon, in Hebron. Dillon described them roughly in this manner:

"The glass-house in Hebron corresponds in smallest detail to its old Assyrian precursor. In the glass-house (mamal al zagag) there stands a large dome-shaped and divided furnace with a chimney at the top and side openings (abwab) of different shapes. Fuel was placed into the hearth (hariqor nar) through a square hole. The working holes were round like those through which, by means of an iron pipe (manfach), the purified glass (mustawi) was taken out of the "frit" (machbuta). In this Hebron glass-house it is surprising that the blowpipe did not have the usual mouthpiece. The glass-blower who stood or sat on a saddle (sarg) worked with the simplest of implements e. g.

with four-edged tongs (murabba), shears (muquis) and pincers (maschiya). The finished product is cracked off the punty (hadida) on which the glass had been attached at its foot and placed in the annealing oven (kawara) which was wide and whose openings — for unknown reasons — resembled gothic arches. The annealing oven in Hebron is attached to the furnace. The glass pastes (taswiq or mina) which served for the production of bracelets (sawar plr. sawir) and especially for glass beads (charaza) were made in a special little furnace. In Hebron glass bijoutery was made for the home and foreign markets just as in Phoenician Tyre and in Egyptian Eustat; it was sent to the Caucasus, to Central Africa, to Borneo as well as to the whole known world of the time."

The Glass-Makers

C. J. Lamm maintains that in Rome the Jews formed the backbone of the glass trade and from this he draws immensely instructive conclusions for medieval glass-making in the East. He says that the Jewish origin of the glass-makers in the Orient where the Jewish glass-workers formed whole families — especially in production and trade in Syria — had a direct influence on the fact that the oriental glass-artists in the Middle Ages did not belong to the "upper classes", in spite of all the privileges which they enjoyed in the Byzantine Empire. In Venice later this was the case. The same author says in this connection that it was to this Jewish co-operation that the Syrian glass owed its extraordinary success and widespread popularity all over the world. He bases his assertion on the fact that the Syrian Jewish glass-makers, as known, possessed whole merchant fleets which took the Syrian glass to all countries and made their world reputation. Syrian glass was even exported to Egypt — the home of glass-making, the land of the excellent medieval art of glass production.

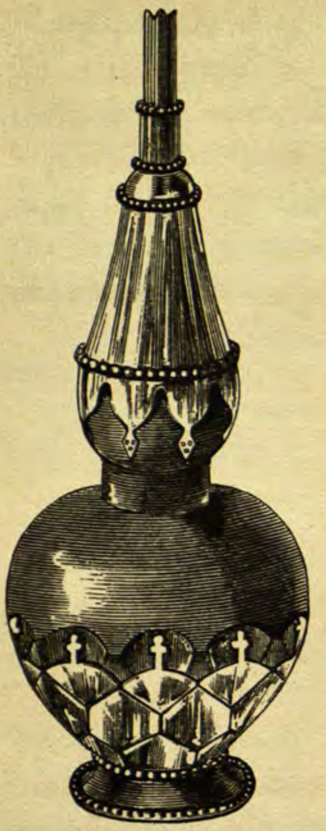
And from this the author draws the conclusion which is somewhat daring that we owe it to this same Jewish element that in the ninth century glass in the Orient was semi-unified and assumed a style and traits common to certain districts and periods.

The political decline of the caliphate meant a tremendous revival of the centrifugal tendencies of style in glass-making as in all the arts of the Islamic peoples, just as we had witnessed at the fall of Rome. The Islamic and the Byzantine art of glass-making (which is less well known to us) developed gradually out of the antique, but not from its highest, comparatively uniform period, but from a later stage in which territorial differences were already clearly evident.

The Products

There is a precious article in the Paris National Library which originates from the sixth century after Christ. It is

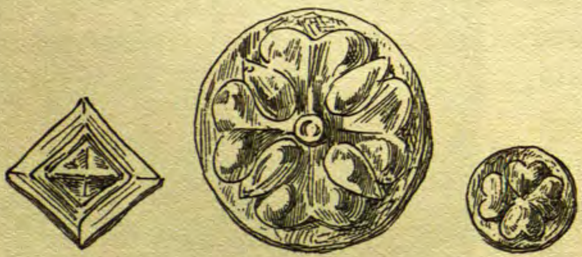
49. Persian enamelled flagon. Reproduced from Felix Slade.



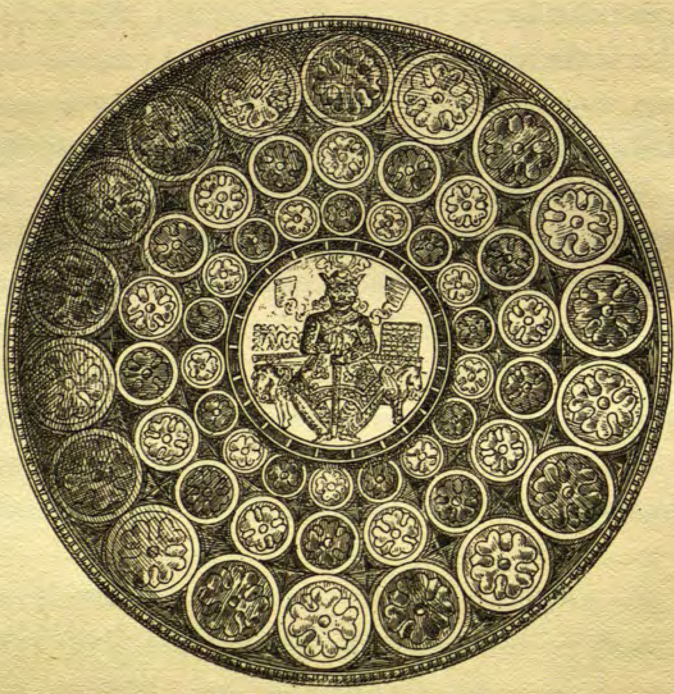
50. Early Arabian lamp, probably from the tenth to eleventh century A.D., from the court of the Fatimes.

a bowl made of thick gold leaf with many ring-shaped interstices which have been inlaid with beautiful disks of cut glass and rock-crystal. This bowl was dedicated by Charles the Bald to the Abbey of St. Dyonisius and was preserved there until the year 1797 as "Solomon's Dish". The ancient portrait of a king in the centre of the bowl was considered by Charlesmagne to be a picture of Solomon and only Longperrier in the year 1638 discovered that it was no other than the Persian king Khosro I, known as the Great, of the Sassanide family who reigned from 531—571. Charlesmagne had received this really magnificent, old, Persian work from the caliph Harun-al-Rashid.

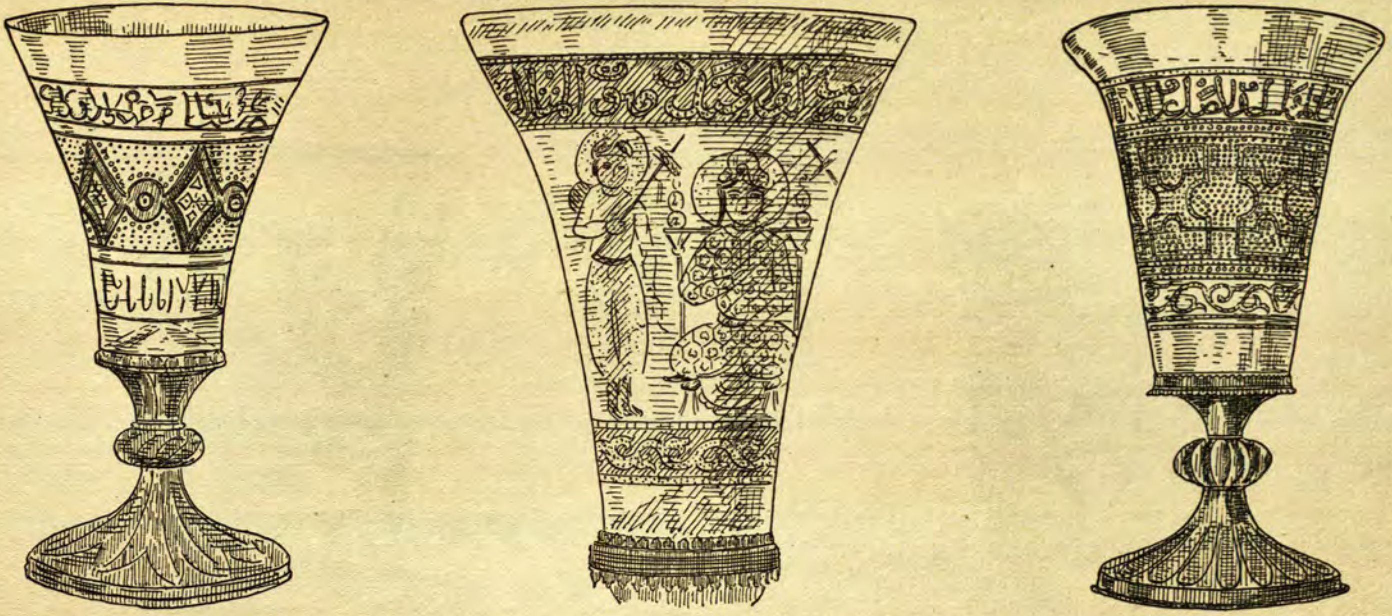
A similar present is known from literature, also a truly royal present: In the year 988 the Emperor Constantine VII sent to the Caliph of the Omajade, Abd-er-Rachman III, a self portrait in glass which had been made in the Cloisonné technique (honeycomb glass). This technique was handled in Egypt, Mesopotamia and in Arab Spain. Why the Byzantine Emperor sent just such a product to Spain — from a country where such glass was not being produced to a country which produced it currently — is somewhat enigmatic (with apologies for my impertinence). And therefore I do not believe this. It may have been a mosaic picture framed in metal — which seems more likely. If we turn in passing to the art of mosaic we think first of all of a mosaic, whose origin is ascribed to the reign of Abd-el-Malik (about 691). Today it can still be seen in the corridors of the Jerusalem Rock Cathedral: it represents the jewels of a Persian ornamental belt. This mosaic created by Byzantine artists enables us to glance through a small cleft into the time of Justinian I. The famous Persian ornaments did not stop at the Bosporus but invaded Christian Byzantium. Although it was the work of Byzantine craftsmen it already rouses a presentiment of the luxurious choice of jewels of the Arabian princesses in the pure oriental environment of the time. We have already said that the great masters of Byzantium were called to the East, i. e. to Jerusalem as well as to Damascus, Bagdad, Cordoba and to many other places. But it is not true that all mosaics of this period were exclusively the work of their hands.



51. Persian cut rock-crystal and glass counters from the sixth century A.D., taken from the following dish (no. 54). Reproduced from Gerspach.



52. Gold dish belonging to the Sassanid king Chosrua I; decorated with counters cut from rock-crystal and glass. Persia, 6th cent. A. D. Reproduced from Gerspach.



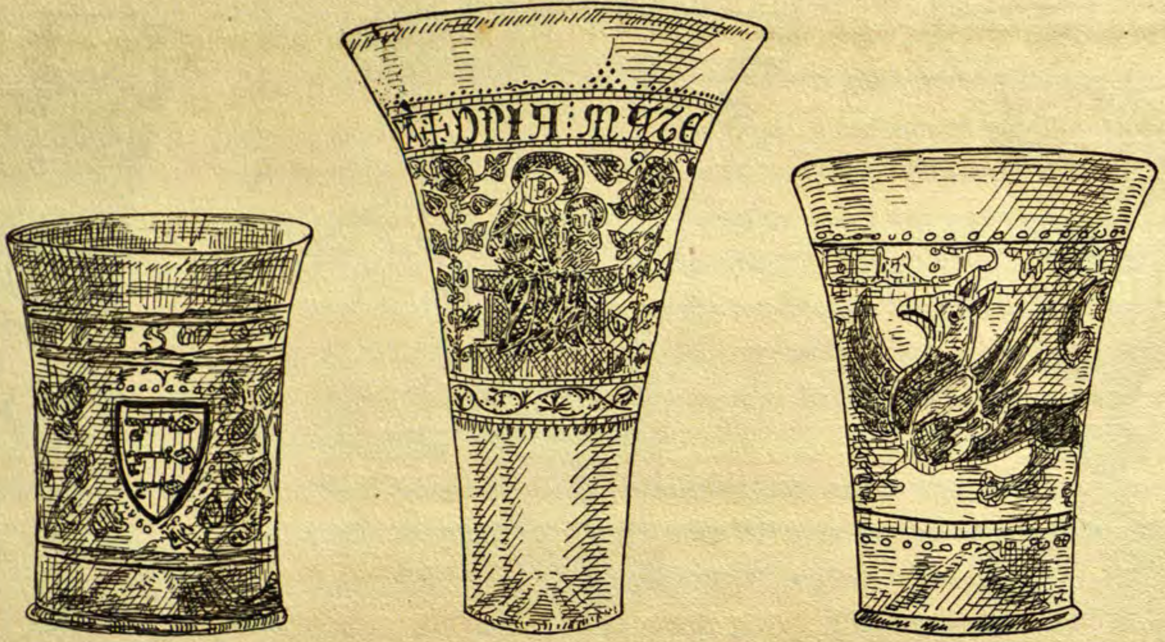
53. Three enamelled and gilded drinking cups from the end of the 12th century A. D. The first originates from Palestine; the third is the world-famous "Charlesmagne Cup"; the centre: beaker set with silver.

One proof for this is the well-known mosaic in Samarra in Iraq. The gold ground, consisting of glass stones and "Millefiori" cubes, is something which did not exist in Byzantine mosaics. This applies also to mosaics worked in mother-of-pearl and variegated pieces of concave glass.

In a different place we shall discuss in more detail the origin of the glass windows in Europe and their development to the painted glass windows of the medieval West European cathedrals. At this point we may not omit the fact that the first attemps to fill in the window spaces gave origin to another Eastern branch of the ancient art of glass-making. Sakkara in the seventh century already had beautiful glass windows, those in Samarra originated in the ninth century and those in Algiers during the eleventh century. Among the most beautiful of all oriental windows are the windows in the mosque in Cairo, coming from the thirteenth and fourteenth centuries.

The living houses and, I believe, the palaces of the Islamic East had no windows to the street because the ground plan of an oriental building surrounding an inner courtyard precluded such. C. J. Lamm found remnants of ancient windows in Samarra, which had been made of very thick glass and supported by glass rods. Apart from square also circular window panes have been found, which are still the custom in oriental baths. During the Middle Ages plate-glass was used in the Orient often for covering inside walls. Such wall covering is used in Iran to this day and its known origins go far back into history. Benjamin of Tudela reported from Damascus in the year 1167 that the walls of the rooms in the palaces there were covered with glass and an even earlier report from the seventh century speaks of a glass pavilion at Hulvan near Cairo. Even public sundials had coloured glass windows.

Speaking of Byzantium of that period we must not forget the Sophia Cathedral. We shall elsewhere discuss the comparatively small windows between the marble ribs. But apart from them, this wonder of the world has a number of magnificent lusters, suspended on chains, from the year 563. They are made of perforated silver plates with spear-shaped glass lattices. When comparing these lamps with the Khosro picture — mentioned above — we cannot but notice a certain distant relationship between those two things. C. J. Lamm believes that the creator of these precious chandeliers is to be found among the Syrian glass-makers. Jewish glass-workers in Syria are named, since he is of the opinion that numerous Jewish glass-masters were transplanted to old Constantinople. Obviously all these



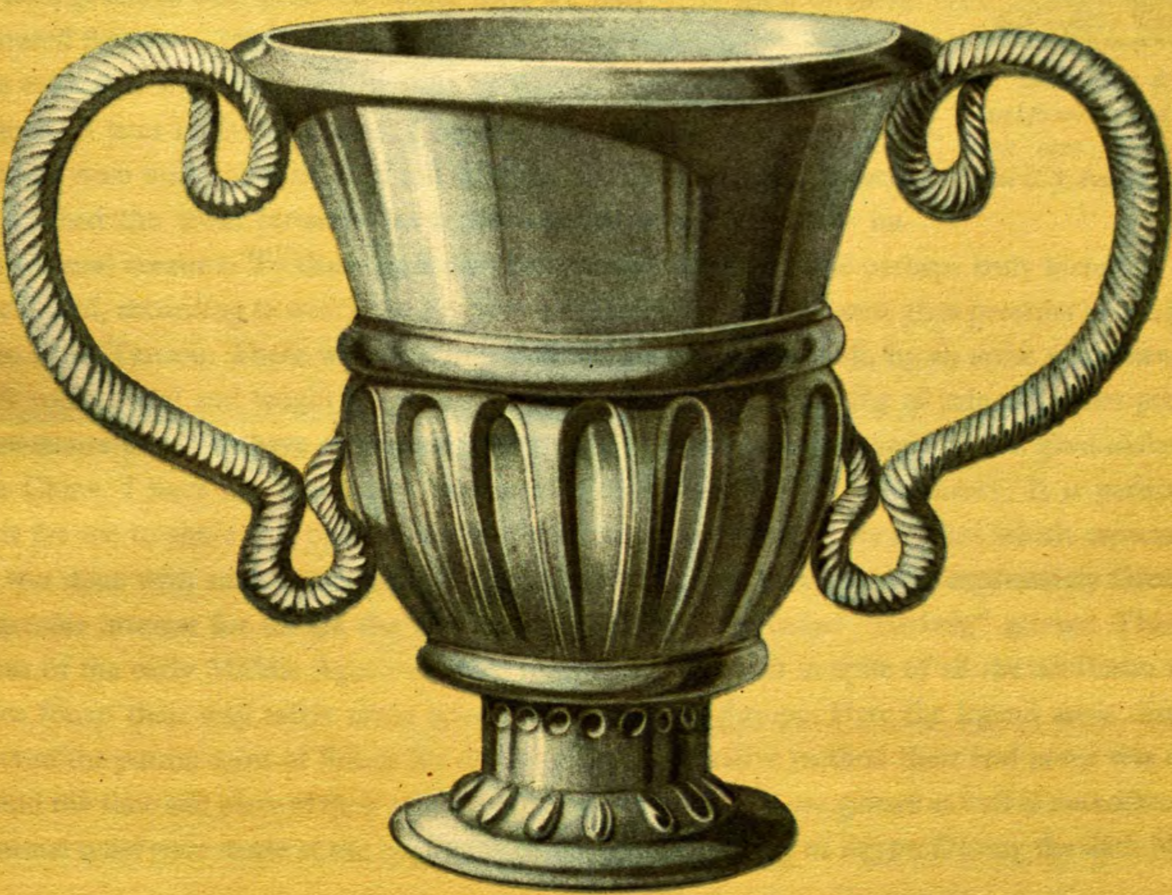
54. Three Syrio-Frankish drinking vessels, richly enamelled and gilded, from the 13th century. Reproduced from C. J. Lamm, vol. II.

considerations about Byzantine glass, of which we have few concrete facts, are pure hypotheses. The Byzantine glass-makers cannot defend themselves against such assumptions, for little can be deduced from the collection of East Roman glass captured by the Venetians and since 1204 preserved in the Cathedral of St. Mark. Nor is the position of the Persian glass-makers any the better, for here too our knowledge is most scanty. No further clues are given by the Persian glass from the year 754 that was found and preserved at the other end of the world: at the far end of the Asian continent in the treasures of the Japanese Emperor at Nara, some more in West Turkestan and all of undoubtedly Persian origin.

All our efforts confirm only the historically sound fact that the Persians as well as the Syrians had known from long the advantage of adding the excess of the previous melt, the "cullet", to the frit which assisted the melting and saved valuable raw materials. It is this circumstance which has prevented archeologists from finding larger quantities of waste glass which might have given some indications of the productivity of the glass-houses. Nor has it been possible to infer that Persia produced less glass than Syria. Having now separated these problematic cases, we must — willy nilly — pass on to discuss the key points, and those are to be found in Egypt, in Syria, Mesopotamia and in Chinese glass production.

Although contrary to normal practice I shall begin with the cutting of glass and rock-crystal, of which the latter connects us with Bohemia as well as with China.

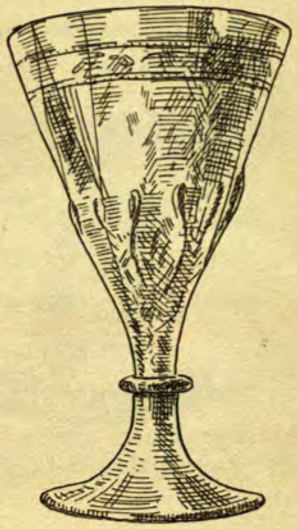
The characteristic lines of Byzantine glass ornamentation betray an Eastern rather than a Western influence. Ostentation, an urge for luxury and the necessary amassing of gigantic capital reigned in Constantinople at the beginning of the Middle Ages just as at the courts of the Egyptian Fatimides. And when comparing the ancient glass vessels of Egypt — cut from rock-crystal — with the Byzantine glass, both of which originated at a similar period before the attack of the crusaders, and with the "Hedwig" glasses I seem to be able to see the Greek cutters as they tried, with their heavy hands, to cut the glass until it revealed all its sparkling lights. There was nothing comparable in the Rhine valley or in places where glass was being made under the Romans. Were they really Greeks, the direct heirs of the creators of the West European "Diatreton" vases and the cameo glasses, the heirs to the Greek artists of old



COLOUR PLATE XVI

Pompej? Or were they those Jewish glass-makers who had come to Byzantium in the sixth century who were not allowed to fashion pictures of men or animals just as later the orthodox Mohammedans? This question can hardly be answered.

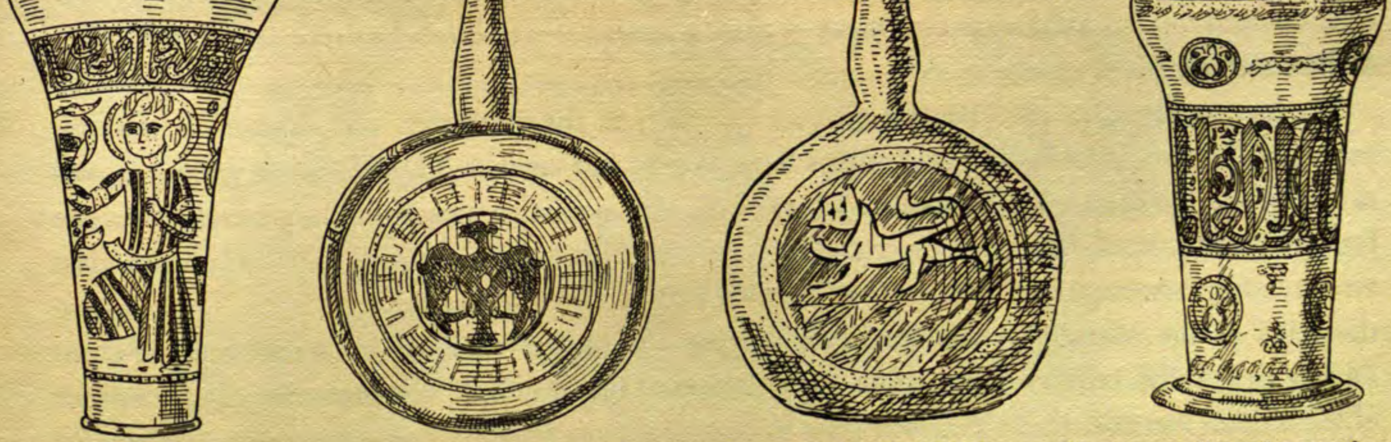
The cut-glass jugs of rock-crystal originated roughly at the same time as the "Hedwig" beakers, and they are in every respect so perfectly worked that they can only be compared with the works of the Italian artists of the Renaissance. They presuppose a long period of development of this art in the East. When it is further reported that the Caliph Mustansir called a collection his own which consisted of one thousand products of rock-crystal and other semi-precious and precious stones then we may — in spite of these exaggerated figures — speak of a local art with a long tradition.



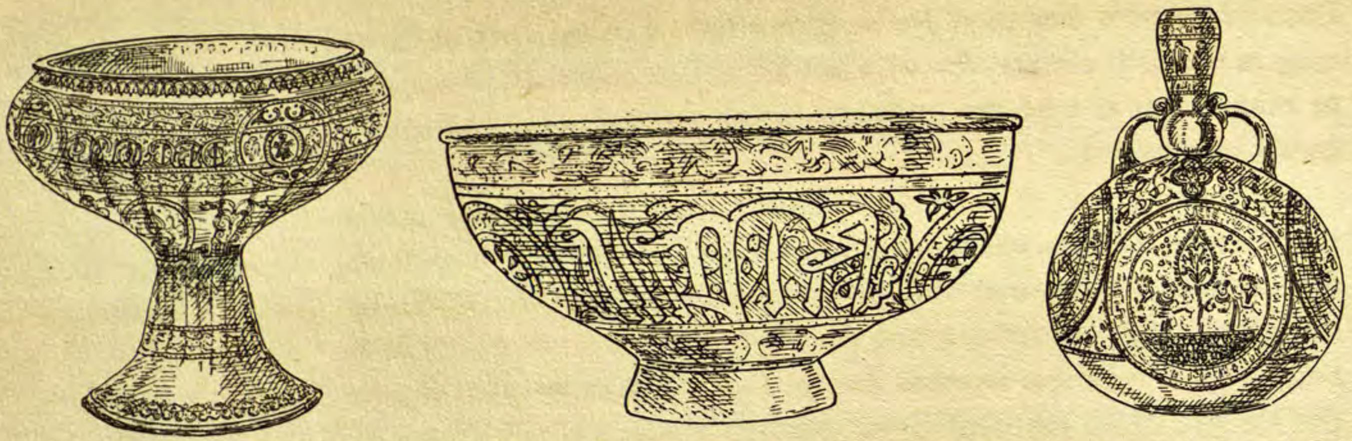
55. Damascene drinking vessel from the end of the 13th cent. Reproduced from C. J. Lamm, vol. II.

This collection was plundered in 1062 by thieves and individual samples of it emerged later in the treasuries of European monasteries where precious reliquaries were made of them. But the addition of precious metals to them rarely reached the level, certainly never the original intentions of the unknown oriental creators. To these legendary products of the East some perhaps truly historical event may be linked, according to which the Emperor of Tatsin (Byzantium) sent glass presents to the South Chinese ruler Taitsou. These were accompanied, on his expressive wish, by an artist who knew how to work rock-crystal and taught his skill to Chinese disciples. The cutting of jade and other precious Chinese stones is said to have originated from this. C. J. Lamm asserts that a Syrian glass-maker was sent to China. I have not found any Syrian glass that might support this theory. It is particularly difficult for me to share this opinion when considering the cutting of sheet-glass which especially in China was done with such dexterity and which follows directly on Pompejan, expressively Greek art.

Of greater interest for us are the goblets which are usually called "Hedwig" glasses. These are treasures of the early Middle Ages — twelve in number — which in spite of all the confusion of the crusades found their way safely along adventurous roads to Europe. Here the legend arose that they had served the patron saint of Silesia for drinking. By comparative method their real home was discovered and the time and place of their origin more closely fixed: for these glasses as well as the rock-crystal with animal relief were made at the beginning of the twelfth century in Egypt. During the dark Middle



56. Drinking vessel from Aleppo, 13th cent., decorated with enamelled and gilded figures. The two small bottles are of a similar time and origin. The fourth is "Luther's drinking cup" from Damascus, made between 1250 to 1310 A. D. Reproduced from C. J. Lamm, vol. II.



57. Luxurious enamel and gild decorated Islamic glass from the 14th cent. A. D. Note Chinese influence. Origin: Egypt and elsewhere. Reproduced from C. J. Lamm.

Ages the calculating slyness of the Church even connected them with the miracle at Cana and made them, together with other glasses, objects of mystical veneration. The fact remains that the Saint of Silesia to whom these glasses were ascribed — after they had perhaps strayed for a moment into Silesia — stimulated the masters there in their choice of motifs for reliefs. Or was it vice versa and does the name give some clue to the similarity of the world-famous relief pictures?

I cannot decide whether it was Byzantium or the Islamic Orient where they used the enamels, known in Antiquity in such large quantities for glass-painting that the glass finally served only as a background. For we know this Byzantine glass much less and its circulation does not reach the proportion of the Islamic art of glass-making. It remains uncontested that enamel and gilding pleased the Orient's preference for colours and magnificence as well as the fact that the Roman heritage of the ancient glass-houses — the beautifully clear, transparent materials — soon became opaque in the Medieval Orient.

But it has never been proved that its opaqueness was not perhaps due to the fact that enamel and colour layers hid the basic features since the categorical imperative of Oriental taste of the time imperiously demanded the assimilation of these foreign materials to the enamelled metal and faience vessels which filled the houses of the Islamic people, side by side with the colourful textiles and highly ornamented rugs.

If we imagine Moorish interiors, the city gates of enamelled bricks, the stalactite caves in which the tombs of Moroccan caliphs have been found, the unimaginably delicate stucco of the richly gilded ceilings of painted cedar wood, the ceilings of the mosques, then it is not easy to assert superficially that what changed the antique glass in the Orient — as we witness it — constituted a decline in the technique of glass-making.

The fact remains that glass became opaque, especially in the thirteenth and fourteenth century, and that all luxury glass was covered with a layer of gold and enamel. This applies to glasses as well as to pipes and to the world-famous chandeliers of the Mesopotamian mosques. The general preference for inscriptions, which flourished especially in these centuries, had its influence on all metal and glass vessels, which sometimes are covered over and over with the florid Arabian symbols. In Egypt during the reign of the Mamelukes this mania for writing was further enlarged by round coats-of-arms. During the twelfth century Syrian glass was ornamented like majolica. The increasing predominance of the Turko-Tartar elements removed glass increasingly more from its original purpose and brought it closer to the materials which were more familiar to the men from Central Asia: glazed clay.

A mention of a Renaissance of Oriental glass-houses in the Mediterranean area refers to the epoch of the eleventh to the fifteenth century. From that time on the Persian glass-houses whose painting celebrated great triumphs right up to the eighteenth century became subordinate to Syria.

In this connection it should be said that in the eleventh century Alexandria still lead with its most distinguished glass, even though throughout the Middle Ages it tended to decline. Egypt produced even at that time more magnificently painted and gilded goblets than any other country. It possessed a large number of glass-houses of which the most outstanding could be found at Fustat. Its old fame rested on the still inexhaustible deposits of natural soda which this country possessed in the salt lakes of Wadi Natrun.

Other reports reveal that Egypt limited its production only to the most artistic and dearest products and left Syria a free hand in producing marketable glass-ware which was even imported into Egypt. Whereas in Western Europe glass was still admired as a miracle, in the East it had long become an object of common use.

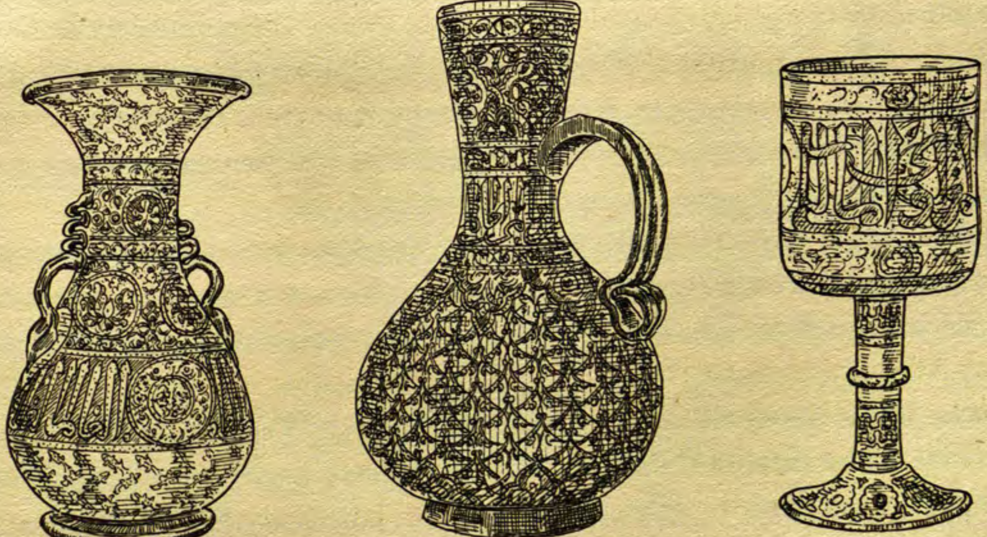
In Tunesia, for example, where already in Antiquity glass was being manufactured, they even made glass door-hinges such as had been used in 1092 by the Greek architects when erecting a city gate in Cairo. Such an enormous gate could be opened by a single guard — thanks to the first ball-bearing. Apart from useful glass for households, alchemy, doctors, and chemists, hairdressers and perfume sellers, lamps, inkstands, sand dials and spittoon also glass hand-grenades, weights and coins, counters and figures of favourite games of all kinds are mentioned.

At that time glass is said to have been so cheap in Egypt that the merchants gave their regular customers beautiful glass vessels in addition, in the same way as nowadays calendars are distributed.

We know nothing of the medieval glass-houses in Syria, Tripolitania or Morocco. Arabia, too, seems to have had no production of its own, in spite of the mention of glass lamps in the Koran. Cyprus production dates from the fifteenth century.

Mesopotamia, on the other hand, had glass-houses — there is proof of one in Mossul. In Iraq glass-making was highly developed in Bagdad and Basra. Here there was even engraved glass which in old Spanish bears the name "iraqua".

Now we must turn to a discussion of Chinese glass to whose history a special chapter will be devoted.



58. Luxurious enamel and gild decorated Islamic glass from the 14th cent. A. D. Chinese Influence. Reproduced from C. J. Lamm.

59. Chinese vase of deeply coloured, cut glass with the symbol of "longevity". Reproduced from Gerspach.

THE CHINESE MOULD STRATIFIED HOLLOW GLASS

WITHIN THE FRAME of a world history of glass the Chinese glass-making undoubtedly deserves comprehensive and thorough evaluation. Unfortunately little is known about it and the scarce knowledge is mainly second-hand. We hope that with the friendly co-operation between Czechoslovakia and the People's Republic of China this ignorance will be removed within the next few years.

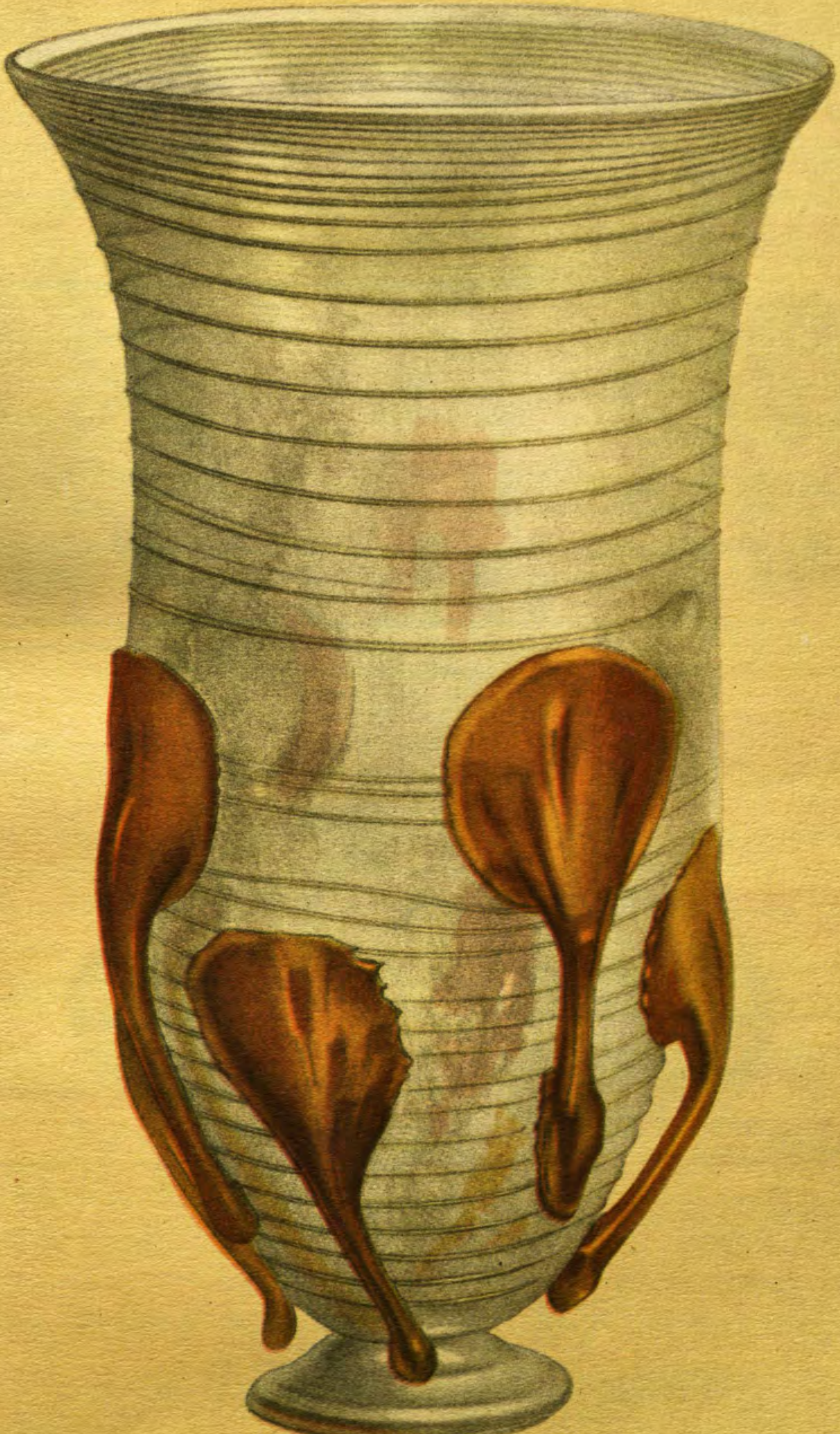
Gerspach says in his "L'Art de la verrerie" that the Chinese records of Emperor U-Ti from the Han dynasty assert that he had founded the first glass-house in the year 140 B. C. Robert Schmidt maintains in the second enlarged and completed edition (1922) of his extremely lively book "Das Glas" that our knowledge of this important sector of glass-making is merely fragmentary. He further relates that Liao (the Chinese word for glass) and Liao Tse chi (glassware) were introduced, according to preserved records, only during the beginning of the third century after Christ. That is under the Han dynasty in China. In old manuscripts we find two different entries about the import of glass during this century. The first consignment apparently came from Syria or Alexandria. For this record — preserved to this day — speaks of the ten colours of this glass-ware as well as of its opaqueness.

From these sources can we gather that glass-making took root in China probably in the fifth century particularly in the northern provinces, where it was called to life by merchants who are said to have come from a country that lay north-west of India, called Ta-yueh-chih. This roughly coincides with the previously mentioned episode, whereby the Byzantine Emperor sent glass-makers to the Emperor of South China who handed his experiences on to disciples there.

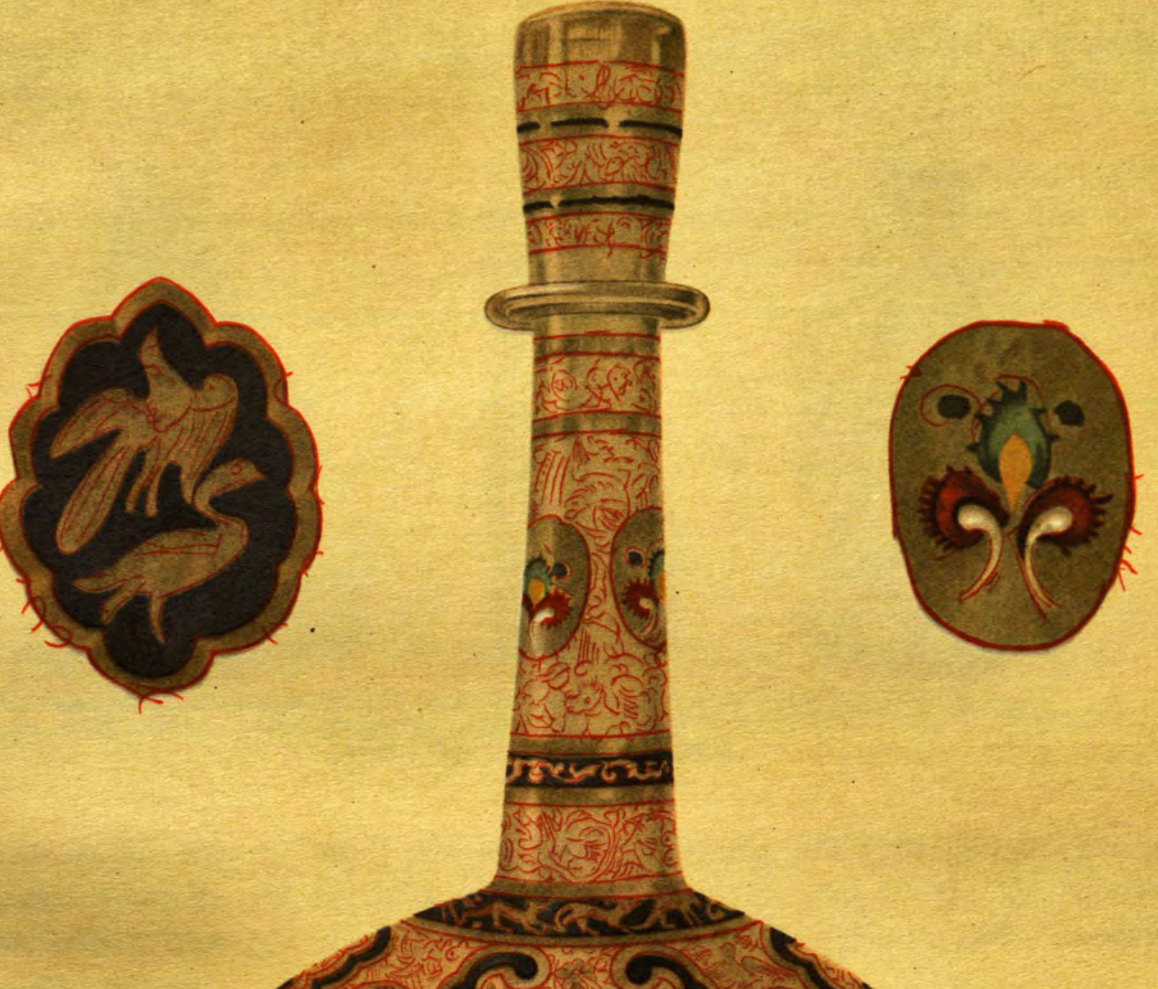
Later the production of glass tumblers, goblets, and beakers was introduced in China which imitated successfully the vessels that had been cut of jade and other stone. But since porcelain suffered no rival, glass production was unable for centuries to reach again the high standard of its initial period.

The famous Arabian geographer Idrissi records the information that in the town Chau Ku glass was being made. In the thirteenth century Marco Polo brought Venetian glass to China and hardly a century later the Ambassador in China, Andolo de Savignone, began a lively import trade.

Our next source comes from the sixteenth century. The missionary Ricci affirms that he personally saw a glass-house in China. And another hundred years later the Jesuit priest Duhalde already reported details (Gerspach p. 312). The Vapereaux collection in Paris has a tobacco bottle of opaque cut plate-



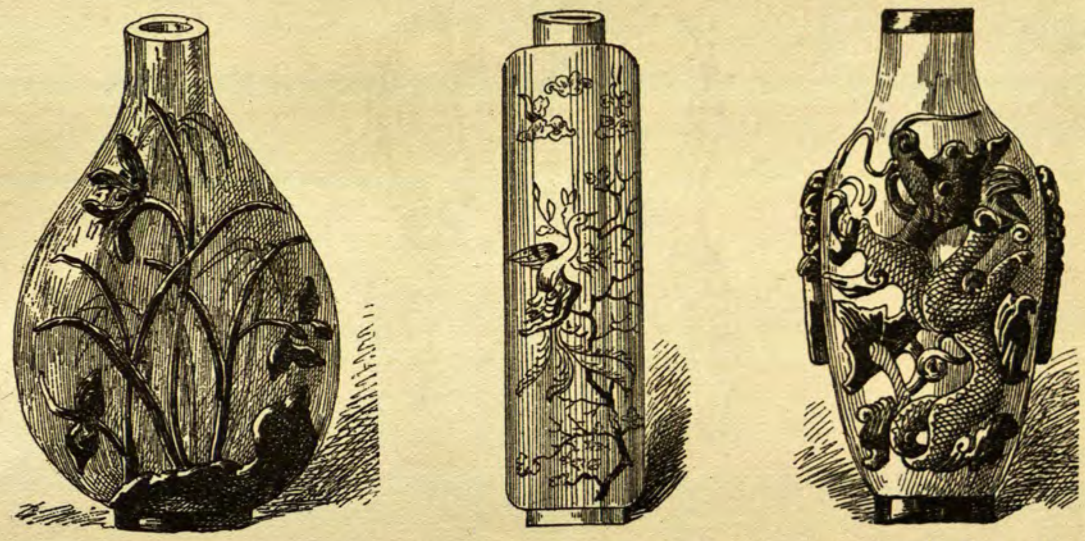
COLOUR PLATE XVII



COLOUR PLATE XVIII

glass from the year 1774, depicted here. According to Schmidt, there was a Renaissance of artistic glass in China at the end of the seventeenth century which apparently was due to a Jesuit missionary who advised Emperor Kan-shi to set up a glass-house in the Peking Emperor's palace. Glass was produced exclusively for the court. Its products bear the engraved signet of the dynasty to distinguish it from contemporary porcelain whose trademarks were painted on.

At the beginning of the reign of Kieng Lung, there was a famous director called Hu, whose products were even imitated in the most precious porcelain on direct order of the Emperor.



60. Three Chinese "tobacco bottles" of "cased glass" with relief decorations cut in the ancient fashion. Reproduced from Gerspach.

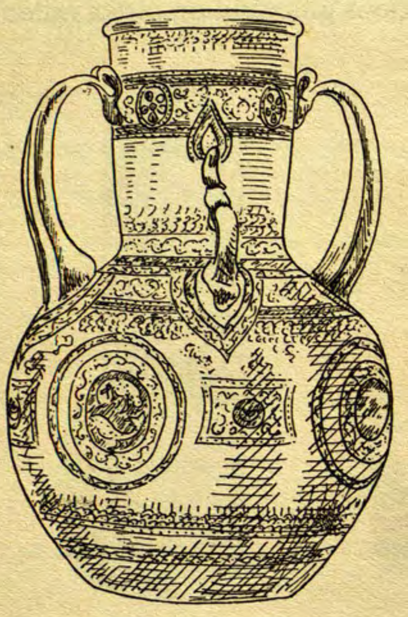
In the new era the centre of Chinese glass-making was in Poshan hien in the Shantung province. From here the raw materials were sent in the shape of bricks mainly to Peking, where in the best-known glass-houses artists of fame were busy creating the most varying forms of ornamentation. Canton also had a busy glass industry.

The Chinese were experts especially in colouring with metal oxides, of which they preferred the blue, green and yellow shades which they managed to tint in an inimitable way. Other colours were known also; for example, a magnificent deep, ruby-red which was made already in the eighteenth century. It is quite impossible that Kunckel's secret of gold-ruby glass should have found its way here. In bright light this Chinese purple glass gives a dull greasy lustre and its surface seems somehow opaque. "The glass of the golden star" as the Chinese poetically call their Avanturin glass was imported from Europe during a relatively recent period, it is reported. A special modification quite unknown in the West is the cracked glass Chao po-li, perforated with fissures; in contrast to the "cracked" glass which had already been made in Venice and is still used today (usually produced by submerging the glowing glass into cold water until it cracks; these fissures are then fused by re-heating in the furnace), its surface is quite smooth.

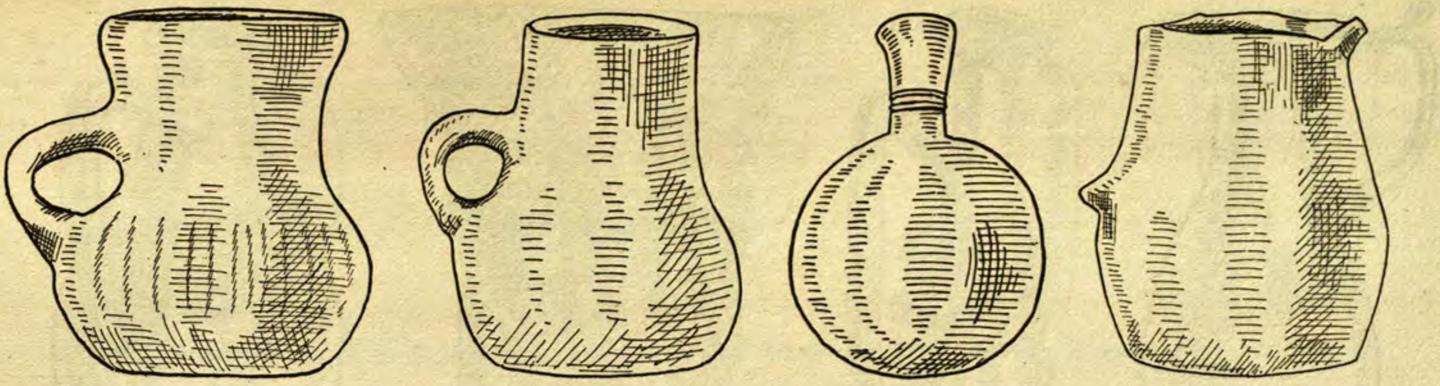
Finally there is talk of rice glass, whose milky, slightly dulled, opaque mass is dotted with firm opaque grains — which is a Chinese invention and whose production process, I believe, we do not know.

Glass-blowing, this basic technique of European glass-houses was unknown in China until recently. Only a single modern cup in blue colour has been diagnosed as normal hollow glass. All previous vessels were moulded in forms, and here is the basic difference between Chinese and European glass in which I include also India and Islamic-Arabian glass-ware.

Whereas the orthodox countries of glass-making created their own styles in glass-blowing by taking advantage of the special character of the material, its ductibility in a viscous state, reaching its highest triumphs in the lightness and charm of the Venetian achievements — in China there were no special forms for glass; each Chinese glass vessel might equally well have been made of metal, jade or any other material. This explains the Chinese preference for opaque glass.



61. Antique Chinese enamelled and gilded glass jug, from the 13th—14th cent. Found in China. Reproduced from C. J. Lamm, vol. II.



62. Shapes of ancient, undecorated glass from the U. S. S. R. 1, 2, 4: Caucasian glass from the 7th — 9th cent. 3: Bottle decorated with thread glass, Ukraine, 7 th cent. Reproduced from C. J. Lamm, vol. II.

RUSSIAN GLASS PRODUCTION IS VERY OLD

WEST EUROPEAN GLASS historians until recently had no conception of the mighty and long development of glass production in the extensive areas of the East. Already when seeking sources for the history of Byzantine glass we actually find nothing fundamental and guaranteed — apart from two imperial orders, a report by the monk Theophilus and a few magnificent exhibition pieces in Western museums. And yet the Byzantine glass production lasted and flourished as the heir of the highly developed antique Roman production for over a thousand years and belonged certainly to the most important glass production of all times and countries.

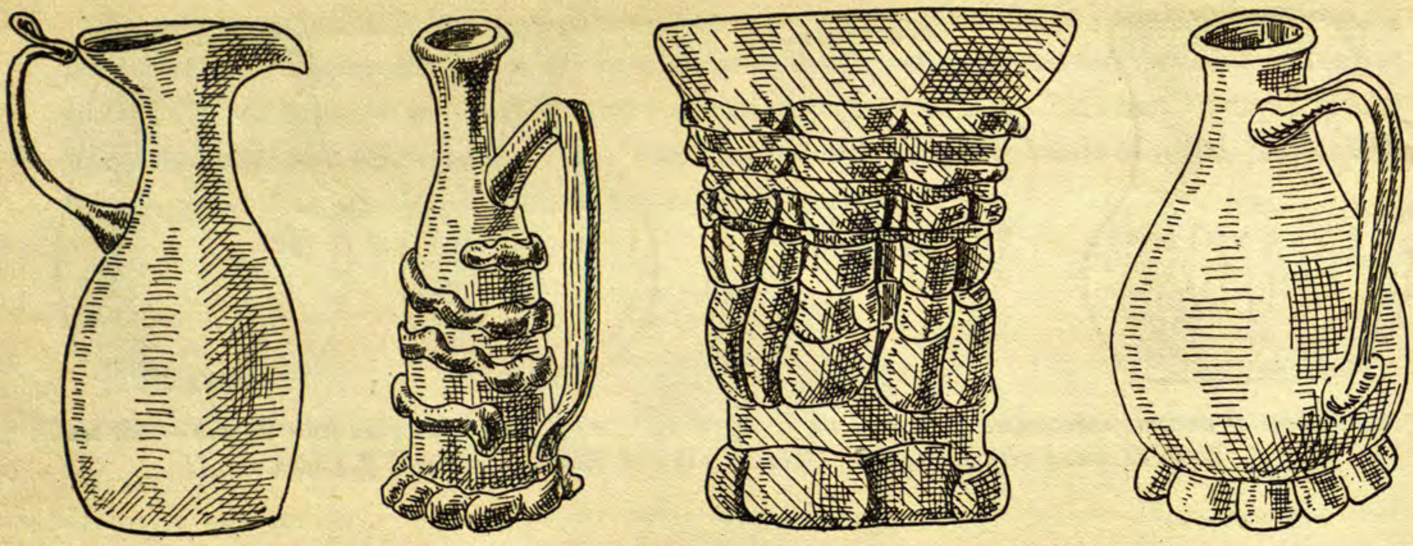
Theophilus bequeathed only an accidental post-scriptum in his key work to the knowledge of medieval glass techniques of which — as from a seed — a comprehensive science has sprung up.

He wrote: "The real art of applying enamel (on glass) was invented in Russia . . ." Scientists from the West, who, of course, are "Western" in orientation, were long deaf to this report and only the study by Dr. Arne and the glass collection which M. de Massoneau brought to the West proved the importance and width of the problem. He dealt with very old Russian glass, with problems which hitherto had not been reckoned with at all.

Under the name Russia one must understand today's Ukraine, especially around Kiev, where the Norman seafarers had built a castle on their way from the conquered Baltic provinces on the partially navigable river Dnieper, which showed them the direction to Constantinople. From Kiev a comfortable trade route led from the so-called Bug roughly to today's Lvov and then via Cracow to Prague. The Spanish Arab merchant Ibrahim mentions this important route. At that time, Kiev was in cultural and ecclesiastical respect entirely under the influence of Greek Byzantium.

The historians of Russian glass-making and ceramics, M. A. Besborodov, Member of the Bielorussian Academy

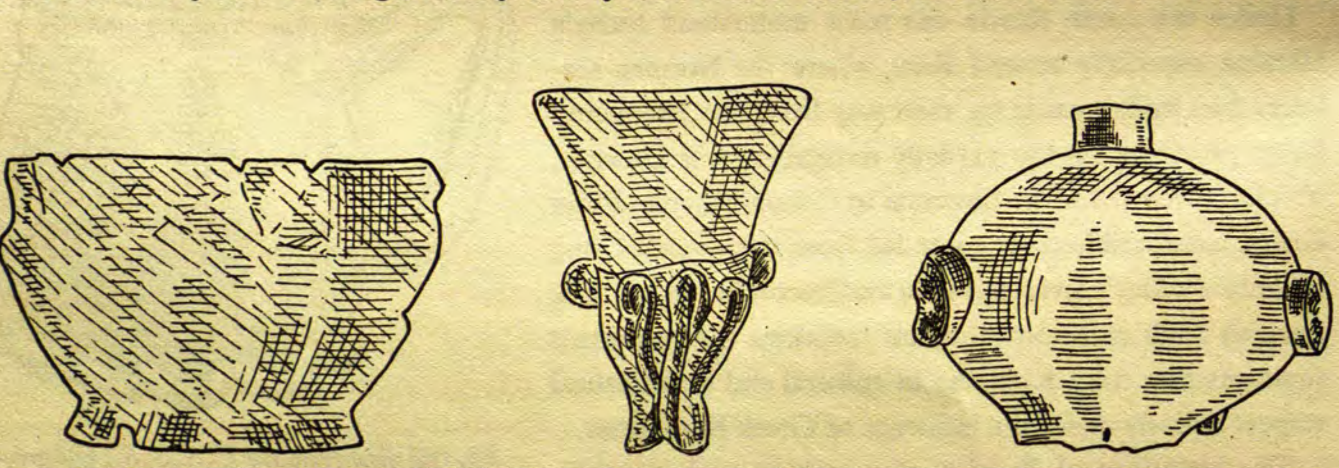
63. Old glass from the U. S. S. R.: Old greenish jug with fired decorations. Found in the Ukraine. Reproduced from C. J. Lamm, vol. II.



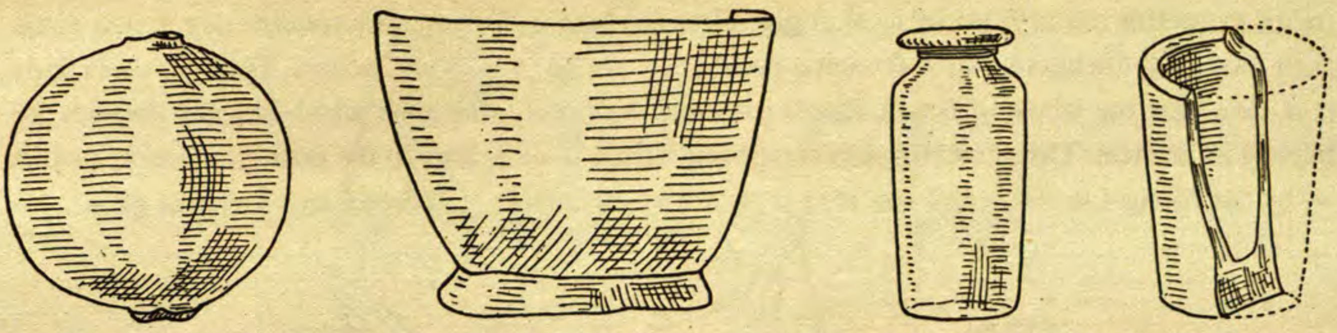
64. Old glass from the U. S. S. R.: 1. Caucasian jug from the 7th — 9th cent. 2. Small jug of brown glass, decorated with irregular threads. Ukraine, 9th—13th cent. 3. Goblet of light-green glass, surrounded with glass threads. Poltava, Ukraine, 11th—3th cent. 4. Small Ukrainian jug of same period. Reproduced from C. J. Lamm.

of Sciences, disagrees with A. K. Chugunov. The latter's statements in his well over one hundred year old dissertation to the Imperial Economic Society at Kasan on "The History of Russian Glass-making" influenced Mendelejev and Pjotukhov. M. A. Besborodov contests the assertion that the first glass-maker on the territory of the Soviet Union was the Swede Elias Koet. It is said that Czar Michael Feodorovich granted a concession "for producing and trading with glass-ware in the Moscow principality" to which the assurance was attached "that no one else should be allowed to found a similar undertaking." M. A. Besborodov is led by the archeological research which V. V. Khvoyko carried out at the turn of the century in the north-western part of Old Kiev. The findings there coincide with reports by the monk Theophilus from the Halmershausen monastery at Paderborn in Westphalia.

The Kiev excavations have shown that at the beginning of the eleventh century — at the time of the historically documented fire — there was a large glass-house in the area around the "Church of the Ten Saints." They produced not only enamel bowls, rings and bracelets but also special, coloured glass of a quality unequalled since Roman times anywhere in the barbarian West, except in Constantinople. Glasses that were found and fragments prove that the glass vessels of the Kiev workshops were immensely fine and fragile. They usually had a thick bottom, otherwise were thin-walled and



65. Old glass from the U. S. S. R.: Various shapes of Ukrainian folk vessels made between the 7th and 9th cent. Reproduced from C. J. Lamm.



66. Old glass from the U. S. S. R.: Various shapes of old Ukrainian folk glass vessels made after 1000 A. D. Reproduced from C. J. Lamm.

their transport may have been very complicated. Nevertheless, vestiges of Kiev glass were discovered at a distance of 1 100 km, in the environment of Leningrad, in Sweden and in former Galicia.

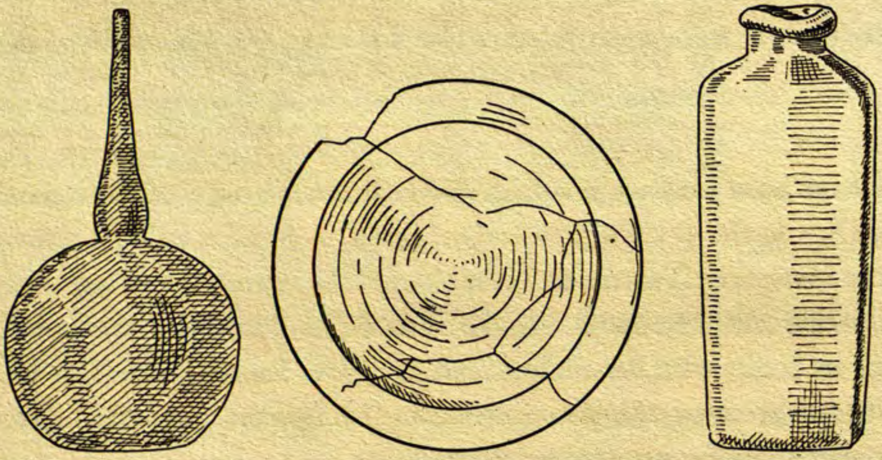
The invasion of the Mongolian Tartars in the first half of the thirteenth century completely destroyed this old craft. The Ukraine came first under Turkish, later under Polish rule and ceased to have a cultural life of its own. Since its bonds with Russia loosened, the older Russian historians were of the opinion that it was only with the granting of the concession to the Swedish immigrant that glass production was revived. But research has not uttered its last word yet.

The areas north of Kiev were not so much destroyed during the Tartar invasions as the middle course of the Dnieper; and certain signs exist that in the Chernigov Forests some glass-houses may have survived.

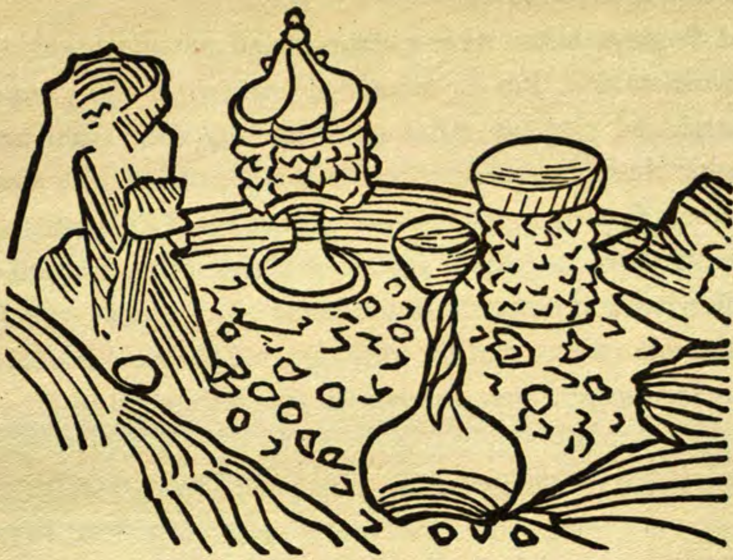
Moreover, C. J. Lamm in his "Medieval Glass and Stone-Cutting in the Near East" I, II, Berlin 1929, 1930, asserts with surprising optimism on the basis of carefully sifted evidence that there must be very many places in southern Russia where medieval glass might be discovered. In the first place he has in mind the Caucasus, where glass was made in the shape of lamp bowls whose gold ornaments bore the names of Georgian bishops. They were of pure Byzantine character and in contrast to numerous other Caucasian glass finds which had been imported from Persia, Mesopotamia and — of course — Syria, these bowls are of local origin.

The reference to Russian glass, that was found in Sweden, applies to the discovery at Birke. The Normans must have transported it by water across the whole of Russia. Dr. Arne describes the way in his book "Sweden and the Orient". The Russian-Greek Mavrogordato collected numerous finds in the Crimea and in the Kuban steps among which there are a number of gilded and enamelled glass beakers. This collection, now named after M. de Massoneau, came to Western Europe. Unfortunately we do no longer know the places where most of these magnificent pieces were found, so that they have lost some of their value for archeologists.

In tombs of the Gothic and later periods at Gurtur and Súuk-Su in the Crimea perhaps the oldest examples of stuck-on decorations have been found. These are attached to bell-shaped decanters with high, crop-like necks which seemed to have enjoyed great popularity in Southern Russia. They originated here. Similar pieces have also been found in the Crimea and the Caucasus as well as in the distant Charkov region. The areas around Novorossijsk belong to the so-called North Arabian cultural area. Another piece of glass was discovered under the altar in the Church at Agar in Georgia. A tomb in Baku contained glass from the twelfth century. Glass in the Tartar graves at Belorechensk and in the capital of the Golden Horde Eski-Seraï (Selisonoye) cannot be of much later origin. Persian and Byzantine glass has also been found near Kiev, but the vessels from the period of the first Dukes (tenth to twelfth century) are of local origin. Near Sbranka in Volynya the country population made their own glass ornaments; such domestic production can be proved in Cherson. From all these finds it is clear that the whole of South Russia produced extremely fine glass which reached districts far beyond its borders. This, however, was completely halted — or at least in the main production centres — by the Mongol invasion and was later replaced by the import of Western and Venetian glass.



67. Old glass from the U. S. S. R.: Various shapes of old Ukrainian folk glass made after 1000 A. D. Reproduced from C. J. Lamm.



68. Woodcut from the work by Jean de Montevillas "Road to Jerusalem" published in Basle, 1475, showing shapes of contemporary glass vessels.

WEST EUROPEAN GLASS PRODUCTION IN THE MIDDLE AGES

THE DECAY OF THE UNIFIED economy of the Roman Empire reduced West and South European glass production to its original low level. In the fourth century glass-making had reached its peak and from then on, the experiences and the skill of the Romans and their Western provinces (Gaul, Spain, Britain and Germany) were gradually lost and production returned to its initial stage. Results of research prove daily more clearly that after the collapse of Rome one may not speak of a complete disappearance of European glass-making. We know that up to the fifteenth century whole groups of glass-makers, invited by the East Roman court, emigrated to the Orient where wealth and privileges were offered to them. And the greatest attraction was the protection Byzantium offered to them and to their highly admired work along the Bosporus and in Salonica.

Those workers who remained true to their homeland and to their people probably did not have such jealously guarded production secrets which were handed on from generation to generation. Probably they were not great experts in the by-now-advanced art of glass-making. Finally the influence of the new society made itself felt here and with it grew the demand for useful goods.

The unhappy tenth century stiffled even the last attempt to regain the former peak in glass-making. And so it is not until the eleventh and even the twelfth century — the assumed life-time of Theophilus — that the curtain rises over medieval darkness and we can spy the first glass-houses in France.

Unfortunately, we again lack sources for the following century. In the course of the famous fifteenth century French as well as German squires made great efforts to attract the most skilful glass-makers to their dukedoms; this may point either to the low, if not critical, decline of production, or to a substantially raised demand. Here, too, even though belated, privileges and charters are granted to glass-makers; they were even raised to the nobility; and all as the result of the lack of beautiful glass.

The new society needed more and more glass and was prepared to expend large sums on it. The feudal lord who granted the glass-makers a piece of forest land, for whose timber there were no economic outlets, made a good business deal. For he demanded one part of the glass production for himself. The lords of the Church did likewise. After profit-hunting their main attention was devoted to competitions in decorating churches and cathedrals which they filled with works of art to satisfy the believers' love of pageantry. Elsewhere the ordinary person found little satisfaction for this.

How was it possible that from its heights the art of glass-making dropped so low, in fact, decayed — e. g. in France and Belgium and especially in the Rhine valley — that only Italy went on producing Roman glass? An explanation may be that the world ignored the glass-houses and refineries for a long time and that there were increasingly great problems in selling those valuable and, at the time, extremely expensive, articles.

It would be a purely mechanical judgment to assume that nobody took the glass-makers' place after they left for Byzantium. That would have been utterly unnatural. The decline occured gradually as the crisis sharpened and the masters ceased to take apprentices. Some sought their fortune by joining neighbouring glass-houses which had assimilated themselves to the changing situation and obeyed the law of demand by producing tableware. This immense decline in quality had one good side: the vases in the pharaohs' glass cases and the jewelled beakers which had displaced even the gold goblets on the tables of the spoilt Roman patricians now were replaced by objects of everyday use. These became increasingly common property: glass assumed a functional purpose.

This is further proved by the fact that the modest "forest glass" continued to be made for hundreds of years in the same quality with only insignificant changes in shape or surface. In this it in no way compromised with the love for luxuries. The general demand for "forest glass" helped the glass-makers in all districts of the rising German "Reich" to become independent. The choice of residence depended entirely on forests and on deposits of sand.

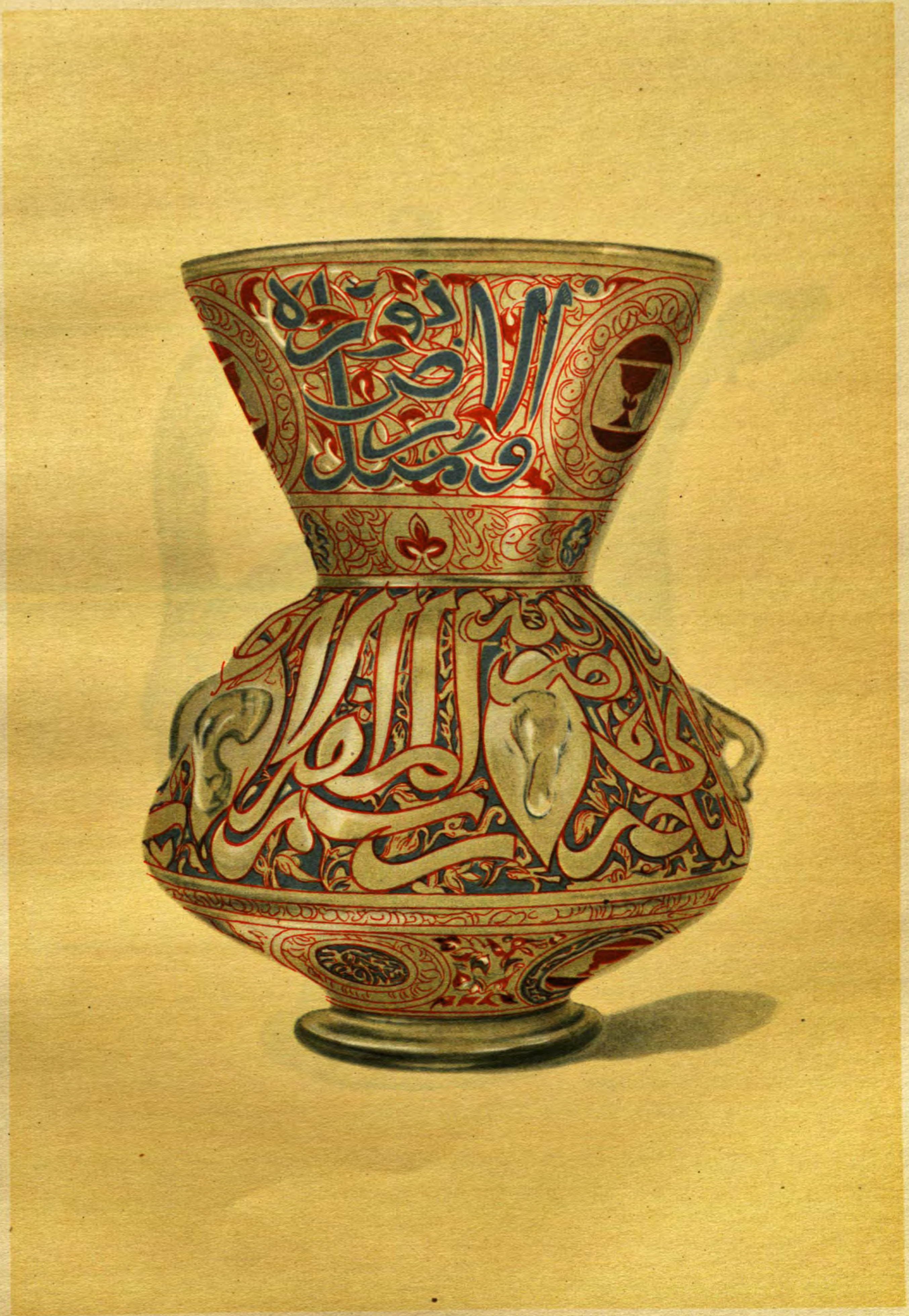
The ancient glass-houses had not stood in such close proximity to the raw materials. We know that the raw glass was melted within reach of the necessary components, but that the actual workshops, where glass was refined and worked, often lay fairly far from these. The glass-houses of the feudal age, however, produced quantitatively much more. The cheap slave labour of Antiquity, which lowered the costs, had disappeared for ever. And so glass-making succumbed to all these changed conditions.

The glass-houses, which began to shoot up like mushrooms as the result of the increased demand, were forced to constant moves, as their furnaces, with all their imperfections, proved to be tremendous devourers of timber. Therefore glass-houses were built very carelessly and often resembled old wood sheds, although they were real gold mines. This rough existence also reflected on the glass-makers, their irregular way of life, their customs, their habits, the unconcern with which often the whole collective moved to near or distant lands where they rarely assimilated to the new environment — be it after long periods of residence. For they lived by themselves, separated from all cultural stimulus by immense forests.

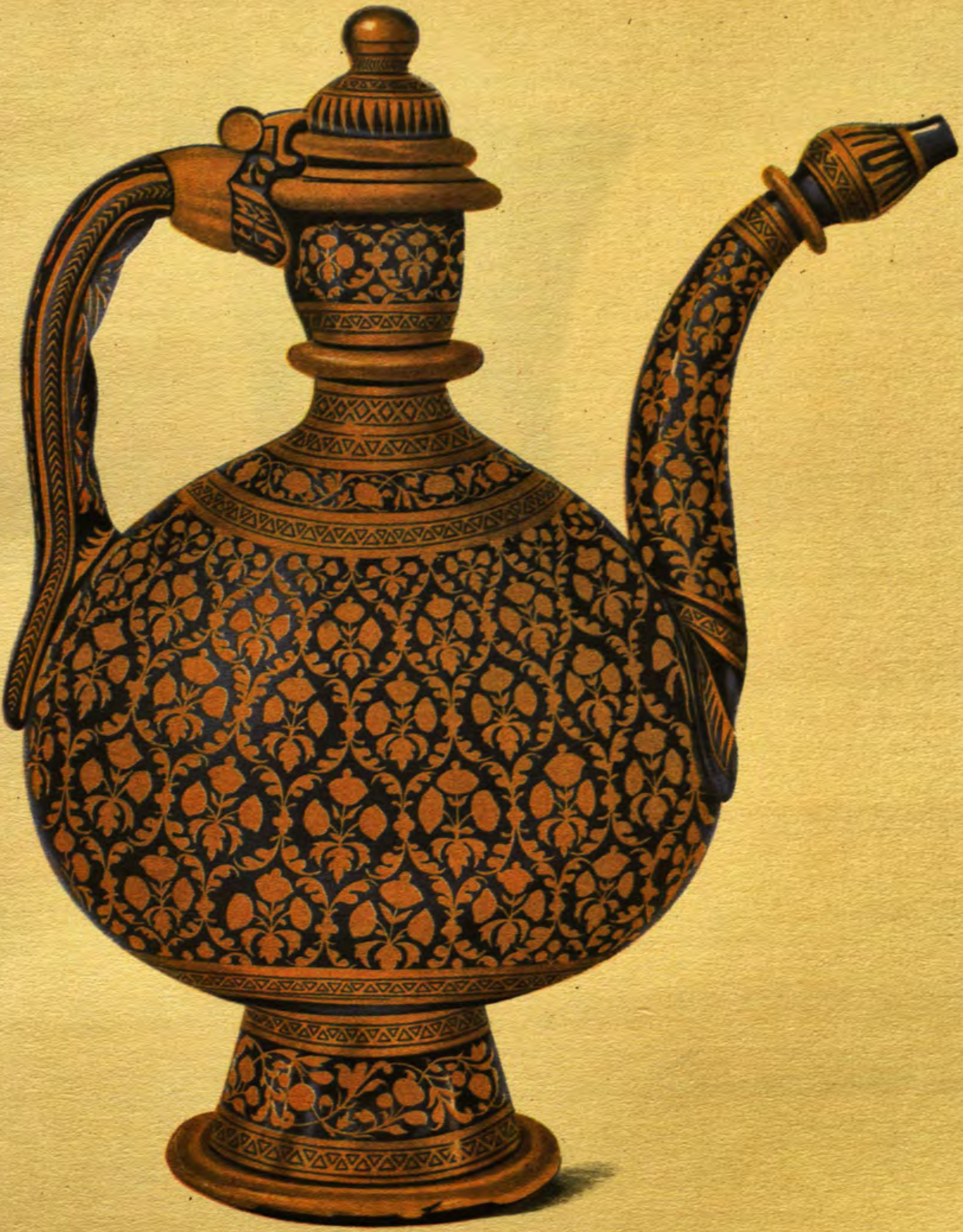
Without this knowledge we should be vainly searching all kinds of legends to find out what caused this one thousand year long period of stagnation in the development of glass-making.

The way of life of the glass-makers — so entirely different from those craftsmen who settled at the crossroads of the developing medieval society — determined their activities and caused this standstill in the development of their means of production; in this glass-making differed from all other crafts.

It would be presumptuous to summarize these thousand years of the Middle Ages in a brief formula

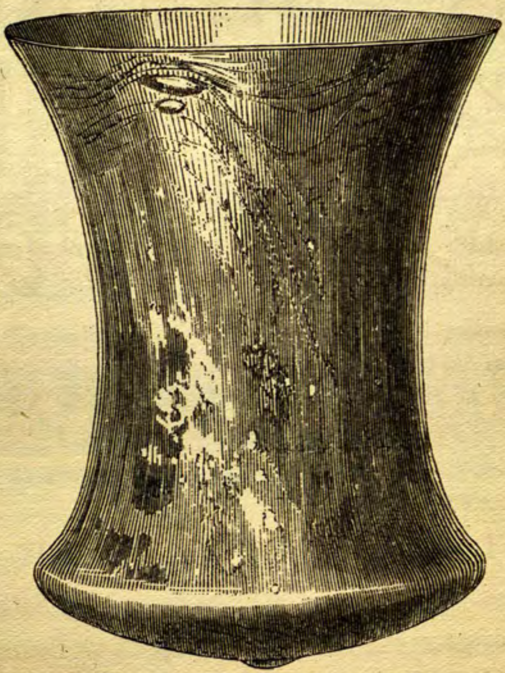


COLOUR PLATE XIX

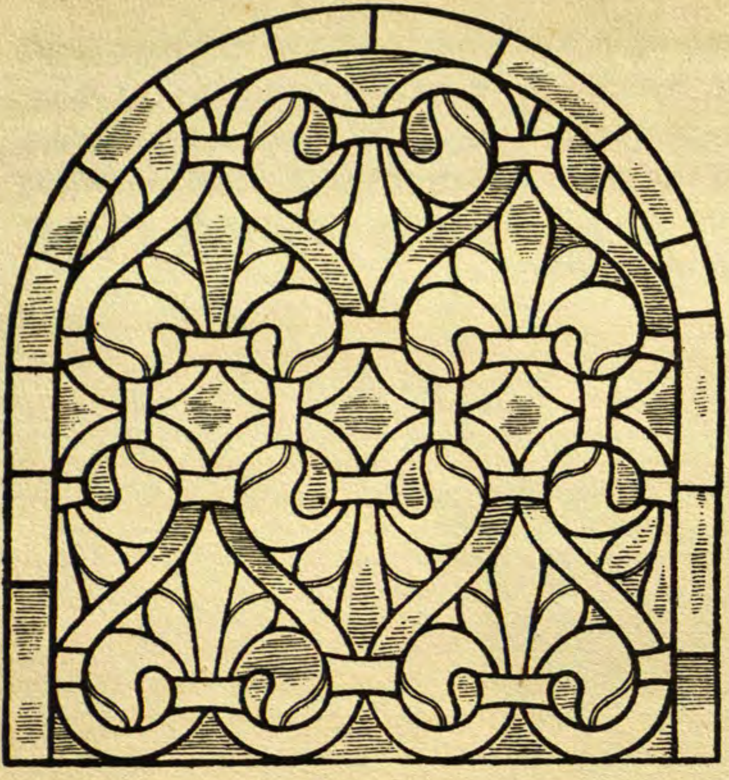


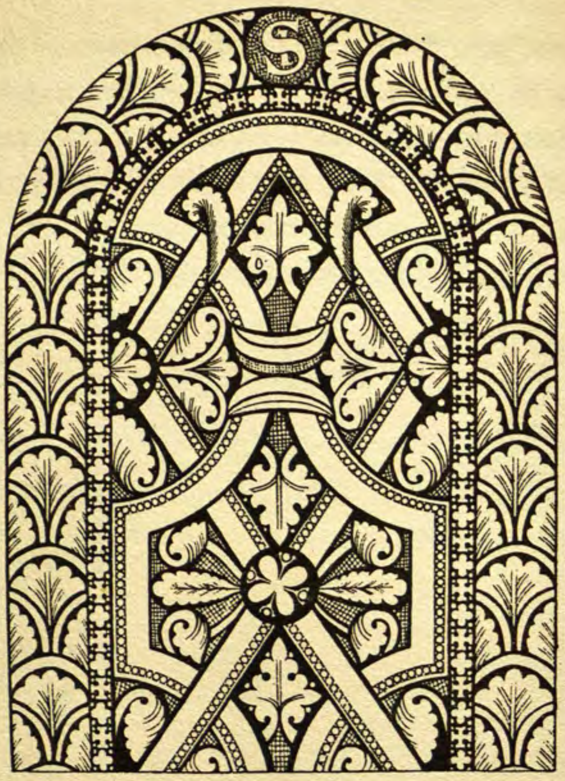
COLOUR PLATE XX

or scheme. We see the Frankish beakers of the fifth to eighth century side by side with the "nose goblets" of the same epoch in varying colours and delicate execution. We hear that Normandie sent its unsurpassed glass-makers to set up a real glass republic right under the eyes of the Venetians. I am thinking of Altare. We finally gaze at the Spanish glass, the lamp in the treasury at Monza, the modern-looking Celtic and Gaulish drinking vessels — all from the early Middle Ages. Considering all this it is better to forego all generalizations and to begin to speak to the point.



69. Frankish drinking vessel. Reproduced from F. Slade.





70. The window in the church at Bonlieu serves as an example of the practical sense of the medieval glaziers. The double lines were formed, not with cames but with drawn lines. (Based on Viollet-le-Duc.) 71. Painted window from the archway at the Cistercian Monastery at Heiligenkreuz near Vienna. About 1300. The ornaments are still entirely Romanesque. (Based on Camesina.)

THE GLASS WINDOW

Not only numbness characterized the medieval epoch in European glass-making. On the contrary, glass contributed — even if slowly — to the development of the basic conditions of human life and social relations.

The most important contribution of medieval glass production is the glass window. Winckelmann made the daring assertion that the glass window did not develop in the Middle Ages but already in Antiquity. J. Labarte wrote in this connection in his "Histoire des arts industriels du Moyen âge et à l'époque de la Renaissance," Paris, 1864:

"Winckelmann declared that he had seen fragments of glass windows in Herculanum. Yet it was only after his History of Antiquity had been written that new, successful excavations supported this bold thesis. In the excavations at Pompej not only fragments of window panes but also window frames came to light which are now jealously guarded in the Museum in Naples."

A reliable text says that even the old Egyptians placed their precious pictures under glass. After Rome had learnt the secret of glass-making plate-glass appeared in the windows which gradually increased in size. Pieces, 60×30 cm large, have been preserved to this day. It must be assumed that the technique, used for plate-glass, enabled the production of larger sheets of glass. The bronze frames, found in Pompej, correspond to a size of plate-glass 54×72 cm large. In the robing room of the baths there must have been a sheet one metre high, 70 cm wide and 13 mm thick which had been dulled on one side. These indisputable finds rehabilitate Seneca and also Philo who described his audience with Emperor Caligula.

The philologists had rejected this description and had declared categorically that what both the one and the other had described was not glass at all, just because "it could not have been so." It can not have been glass, but some transparent stone, perhaps talcum or a transparent shell with which the Ancients liked closing their windows, these people would comment. Well, philologists are daily being defeated by new discoveries. Whereas at the beginning the help of archeologists had to be solicited, after the third century written documents prove the existence of windows.

Let Us Investigate Early Medieval Sources

The Church Fathers as well as secular writers constantly sang about the wonderful effects of coloured windows. First of all it was, of course, the Church which used these. The Christian poet Lactantius, the tutor of Prince Crispus, Constantine's son, wrote:

"The spirit comprehends the objects of the outer world through the eyes of the body as through glass windows."

And the Holy Hieronymus also wrote about glass windows in the commentary to the forty-first chapter of Ezekiel. In the fourth century Prudentius tells of the windows with which the Basilica of St. Paul's — that lay outside the walls of Rome — was decorated: "The arched windows are filled with coloured glass that shines like a flower-covered meadow in spring." Galla Plazida, the daughter of Emperor Theodosius (died 450), had the East windows of the St. John's Church at Ravenna filled in with glass. According to Paul the Silent, the apsis of the Sophia Cathedral in Constantinople was adorned with window glass in the sixth century. This glass was so thin that the sun penetrated in its full force which caused Procopius to remark that it seemed to him as if the day was born in the church vaulting — so full of light was the church.

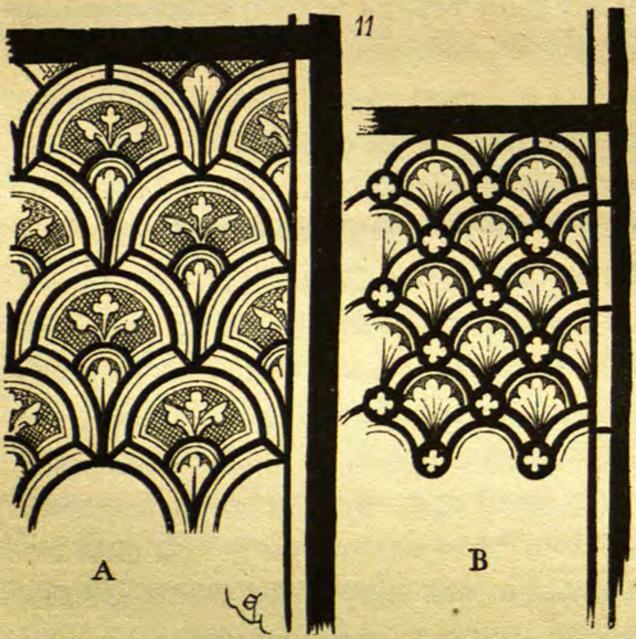
The words with which the Greeks described this glass do not express whether it was coloured; earlier authors had always made special mention of this. It seems that here we have pure white glass, since it did not change sunlight. Glass spread soon from the Greco-Italian world to the whole of Western Europe and mainly to France. In the fifth century many basilicas in Gaul already followed the example of Rome and Constantinople with white or coloured glass windows.

Sidonius Apollinarius, Bishop of Clermont, mentioned in a rhymed poem, written in 450, on the occasion of consecrating the church of St. Patientius at Lyon, that this was decorated with variegated glass. In the sixth century Fortunatus (died 558) described the basilica of St. Vincent built under King Childebert, without forgetting to mention its glass windows: vitreis occulta fenestris. Gregorius of Tours informs us in his "History of the Franks" that during the reign of Chlotar (548—628) thieves entered the church of St. Martin by breaking the window panes; and in another writing he reports that a thief, having broken the window pane, stole its metal frame. And finally St. Ouen in his biography of St. Elias, who died in 663, attests that his holy friend, having entered the city of Limoges and having ordered the doors of the prison to be opened, advised the prisoners to flee into the church. When the convicts reached the Basilica of St. Sulpicius, they found all the doors locked; so they broke one of the large windows "that lit up the entrance hall." From this, one can gather that glass was in general use by the seventh century, that it was even broken to gain entry to the church and that window frames were stolen when the metal was needed for something more important. The latter is a proof for the truthfulness of the documents, since they deal with church windows and we are in the "darkest Middle Ages," of which we have the mistaken belief that people feared their hands would wither as punishment for such sacrilege. On the contrary, even Church dignitaries have testified that quite ordinary people — of course not all — stole window frames from the churches and that they did not behave in the way usually ascribed to them.

The still isolated luxury of the far-too-exclusive glass tells us nothing; we must imagine that its very existence led evolution to the decisive moment where sheet-glass changed the whole of architecture and all conditions of life. Let us imagine, e. g., how the man of Antiquity lived in his dwellings: either "walled in" without daylight, protected in his house from rain and wind, but utterly exposed to frost and chilly dampness. The poets and theoretical admirers of Antiquity pass over these facts in mute silence. It is true that glass in the cathedral windows did not protect man from outer climatic conditions, and it would be worth while to write a thesis one day on how draughty it must have been in the old castles; and how around Christmastide the tender, young ladies would creep under their featherbeds with chattering teeth or loud sneezes in the icy bed-chambers that were built of enormous wet lumps of stone; when sitting by the fire they would be baked on one side only by the direct rays of the hearth . . .

Painted Windows

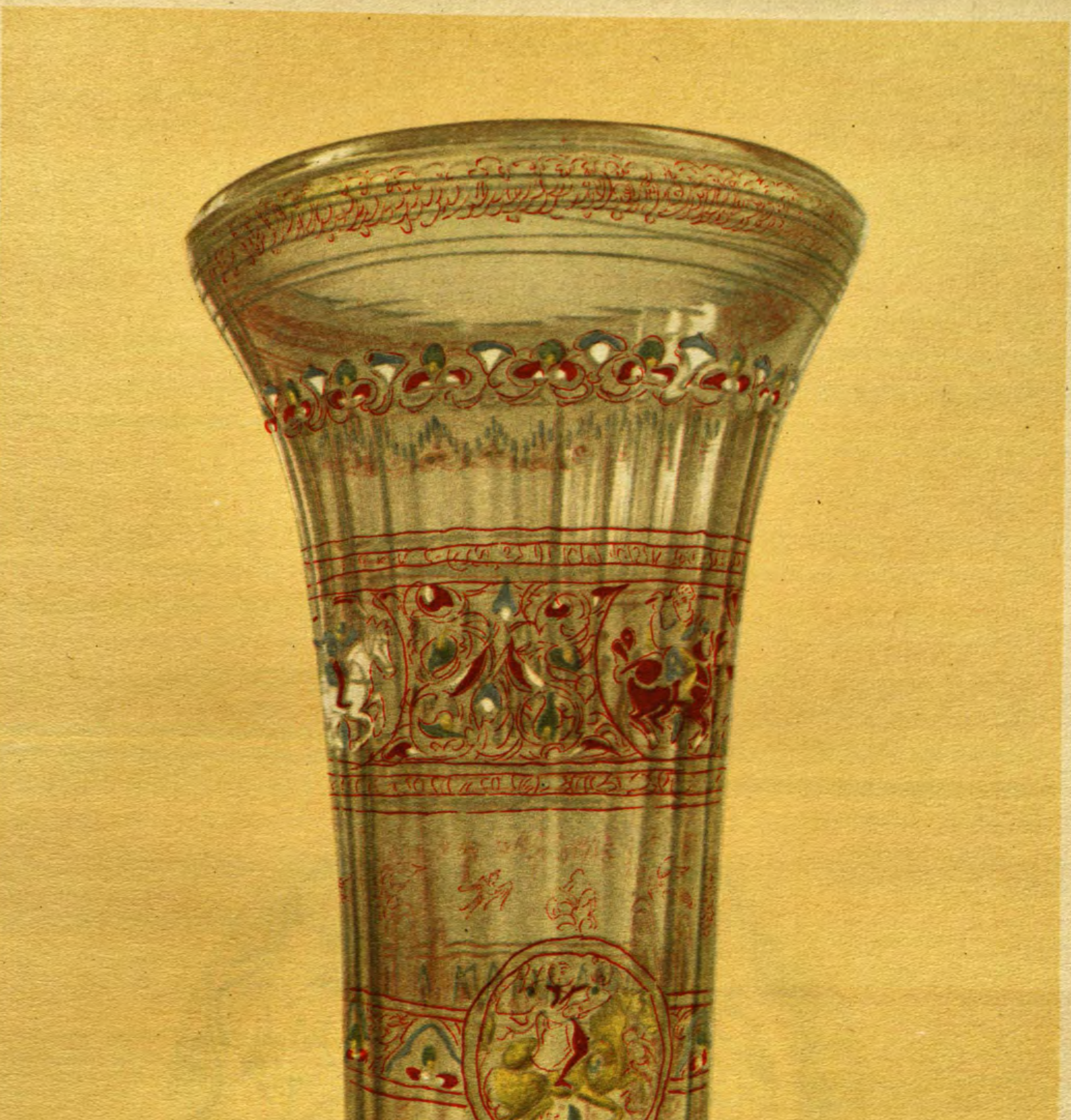
"There were no pictures on the old, brightly-coloured church windows," Jules Labarte continued, "not even decorations. The multi-coloured windows were composed of a large number of different coloured panes which were cut to a certain shape and joined together so that they represented some motif." That is the basic difference between painted glass and stained glass. We already know that in producing stained glass certain metallic oxides were added during melting which gave an even tint of colour, not only on the surface but through the entire glass mass. Here, then, we have stained, not painted glass. To achieve the latter, we must take a coloured or even a colourless sheet of glass and paint it on one or both sides with colours that adhere to glass. Such glass enamels are made of fusible glass with metallic oxides. These, one might say, formed the chassis of the colours and with their help and raising them to a high temperature these colours were fired on to the glass and fused with it at the required places. Since we know that in the first century of our era glass was used for windows and that the windows of European cathedrals were glazed at an early Christian period, let us investigate at what time they began to paint windows with a transparent glass enamel; i. e., by firing. Here we already face greater contradictions than in the first question we set ourselves.



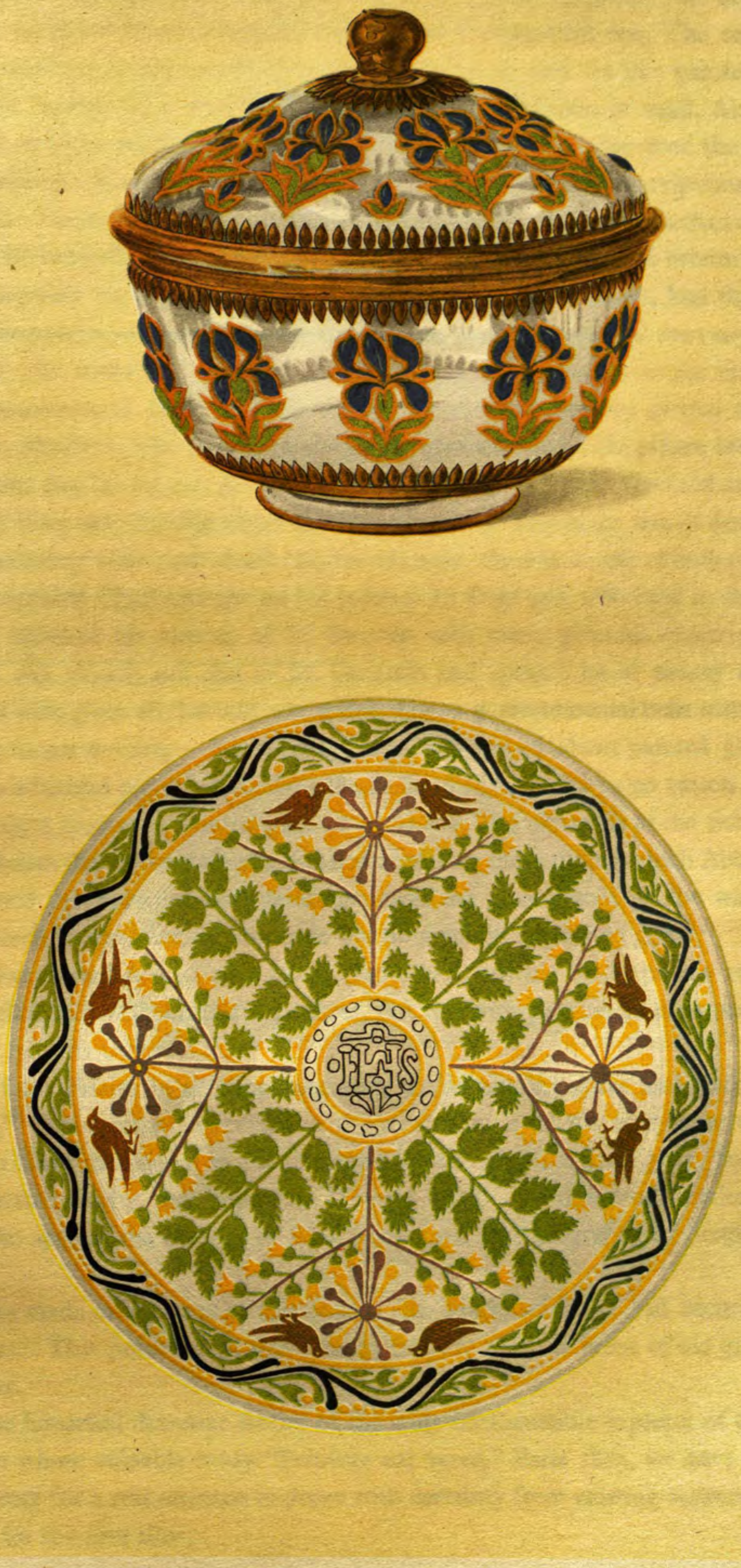
72. Example of two drawings of scale-like window patterns in which the bistre frame subdues the light in order to give the multi-coloured pattern a quiet, neutral character. (Based on Viollet-le-Duc.)

Many of the archeologists who are experts in this respect have unanimously agreed that glass painting did not begin before the eleventh century. Emmerich David, however, asserted that this art went back as far as Ludwig the Pious, or at least to Charles the Bald. On the other hand, these are the words of E. Didron who began to write a history of glass painting (we cite J. Labarte):

"We are convinced that artistically painted glass



COLOUR PLATE XXI



COLOUR PLATE XXII

dates back to the ninth century, owing to the great stimulus given by Charlesmagne to Literature, the Sciences and Arts during his forty-six year long reign. The progress made at this time in all realms of human knowledge led to an expansion of the glass industry. The development had been prepared for two hundred years by the addition of coloured glass to the transparent one. The century to which we owe the first miniatures in old manuscripts also presented us with the first painted glass."

This genial vision merely lacks proof, but on its own no conclusion is valid. Alcuin, Eginhard, Hermold the Black and the unknown monk of St. Gallen, all of whom described the life of Charlesmagne, did not mention coloured windows, although they gave detailed descriptions of the edifices which the King of the Franks had erected. Their descriptions of the Minster at Aachen or the Palatinate at Ingelheim, with its beautiful chapel, mention paintings, statues, marble and bronze lattices — how could they have forgotten the certainly impressive-looking painted windows, had there been such?

Not even the chronicler, who dealt with more details than the historians, had seen any glass painting. The monk Hariulf, who wrote the chronicle of the Monastery of Centule in the eleventh century, described the reconstruction of three churches in the monastery. They were carried out by Charlesmagne's son-in-law, Algilbert, who was Abbot there. He also mentioned the pillars, bronze, and different coloured marble, but he did not say a single word about glass which he would certainly not have forgotten, had there been any. Equally silent were the chroniclers who in the annals described the lives of the bishops immediately after their death, as, for example, the one at the church of Auxerre.

Aron, who accompanied Charlesmagne on his journey to Italy and who died in the first years of the ninth century, enriched his church of St. Stephen with many precious objects; his successor, Angelm, renovated this church and that of St. Germain and spent a lot of money on decorations. Both these churches were given all that was new at that time, e. g. monumental bells with mighty sound. Yes, the chronicler forgot nothing — but there is not a single word about painted glass. The annal writers, who left us a faithful picture of Ludwig the Pious (died 840) give us no reason for assumption that one of them might have seen painted glass in a window. The chronicle of the rich Monastery of Fontanelle in the Rouen diocese contained a detailed report on the building which Abbot Angigis had erected. It mentioned the beautiful wall paintings, even the glass placed in the window openings (fenestrae vitrae) which meant a luxury but there was no mention of painted glass.

Haribald, who was elected Bishop of Auxerre (827—860), had his St. Stephen's church repaired, decorated it with glass and with beautiful pictures, but not with painted glass as some people who distort texts would have us believe.

When we jump from France to neighbouring Italy we do not anywhere find glass painting. The "Liber Pontificalis," whose author described in the most minute details everything with which the Popes then tried to blind the people in the churches, spoke only of stained glass. So the chronicler wrote with indisputable clarity that Pope Leo III (795—816) — a friend of Charlesmagne — had ordered glass for the apse of the Basilica of St. Constantine. In a biography of Sergius II (841) we can read:

"He had windows made in the apse of this church (St. Mark) which he had decorated with glass and different colours." This proves to us that even in Italy, in the true home of old glass, there were no painted windows.

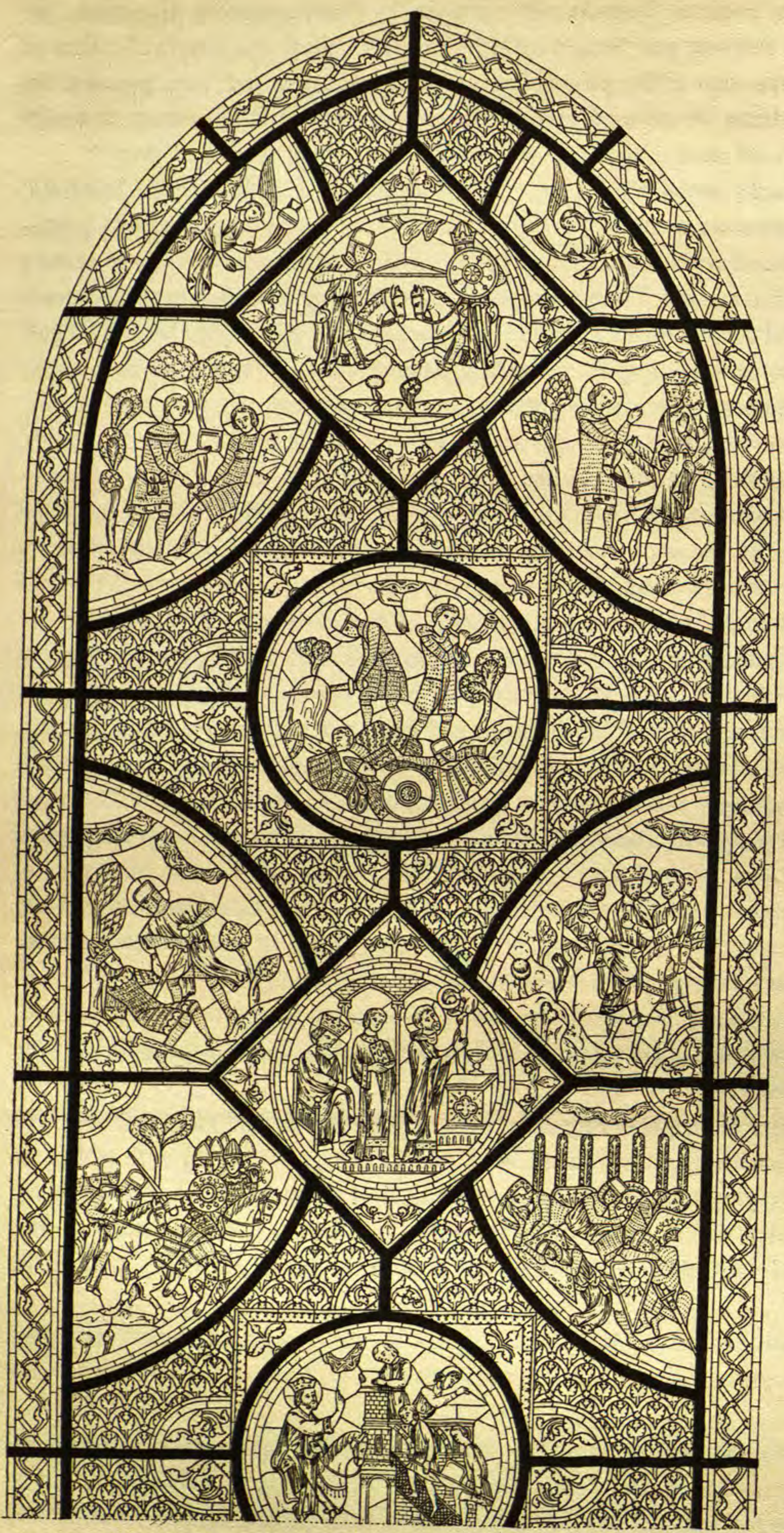
Let us leave these historical detective stories of the truly inexhaustible explorer of old documents, Jules Labarte, from whose valuable study "Peinture sur verre," Paris 1873, we have quoted this to show that it is not easy for a real scientist to prove with certainty from existing sources when painted windows appeared for the first time.

Let us now accompany the same author on a different journey. In his now already historical and most exhaustive work "Histoire des arts industriels au Moyen âge et à l'époque de la Renaissance" Labarte said:

"It is, however, possible that in the ninth century different sections of glass pictures were made from coloured glass which was cut in such a way that it represented outlines of figures on which, for details, ordinary colours were painted. In a word: glass here was used in the same function as canvas or wood. Such windows might create an impression of painted glass and might last a long time."

It seems that, in fact, for a certain period of time this really took place. And we shall see that it was as late as the fifteenth century in Florence that we find what we have been seeking all this time: proper glass painting.

The Cathedral Board of Sta Maria del Fiore called a skilled master from Germany to paint their windows. This artist had several disciples. In the year 1477 the builders of the Bishops'



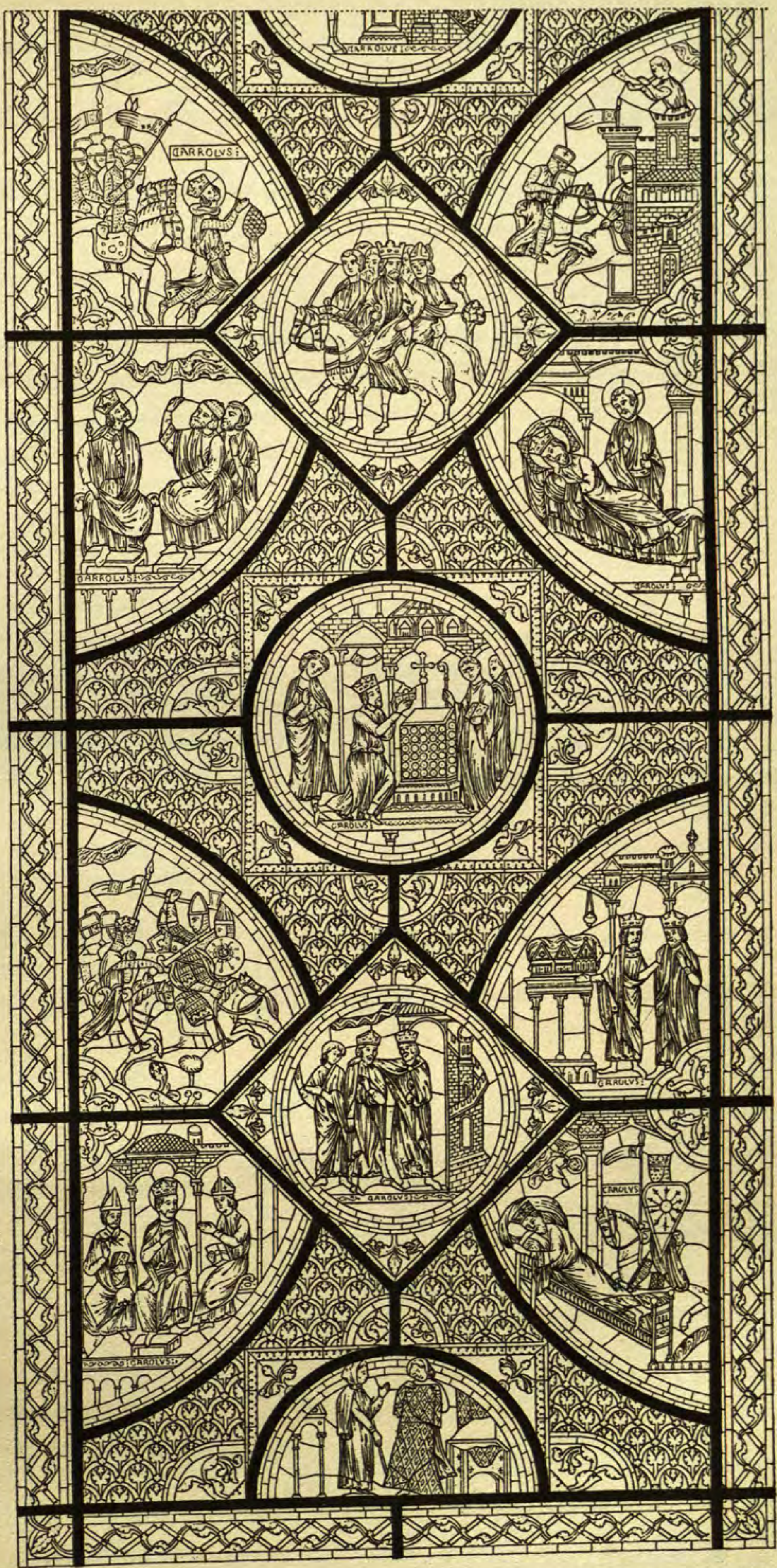
73. "Charlesmagne and Roland" window in the French cathedral at Chartres, painted during the 13th cent. Engraving in Allgemeine Geschichte by W. Oncken, vol. II, 6./1.

Chapel in Arezzo entrusted two monks from Florence with the task of setting up a glass-house. Their contract stated it would not be oil colours, but fired colours ("fritted in the fire and not dissolved in oil," as the Italian original runs). This could never have occurred to the contractors if previous to this there had not been oil painting on glass; and it seems that this had been used in Toscana before the colouring with majolica colours — the semi-translucent colouring — had been introduced.

We can omit the tenth century in our research, for the historian says:

"The tenth century suffered many misfortunes and art, deprived of the dukes' support, disintegrated..." Apparently it was only during the Renaissance, the epoch which opened new vistas to art, that man recovered from the upheavals and setbacks of the barbarian invasions which engulfed Europe during the tenth century.

The return to Antiquity showed itself first in Germany, at the end of the tenth century under Otto II (983); but there is nothing



74. Many scenes depicted on this famous window follow the fashion of the time, in costumes as in habits of life during the 13th century; they do not give at true picture of life.

to make us ascribe the sought-for discovery to the Germans (Labarte). De Lasteyrie cites a report, according to which the oldest painted windows are to be found in the monastery at Egernsee in Bavaria. A certain Count Arnold is said to have presented them towards the end of the tenth century. According to the report of the chronicler, the Abbot Gobert thanked the Count with the following words:

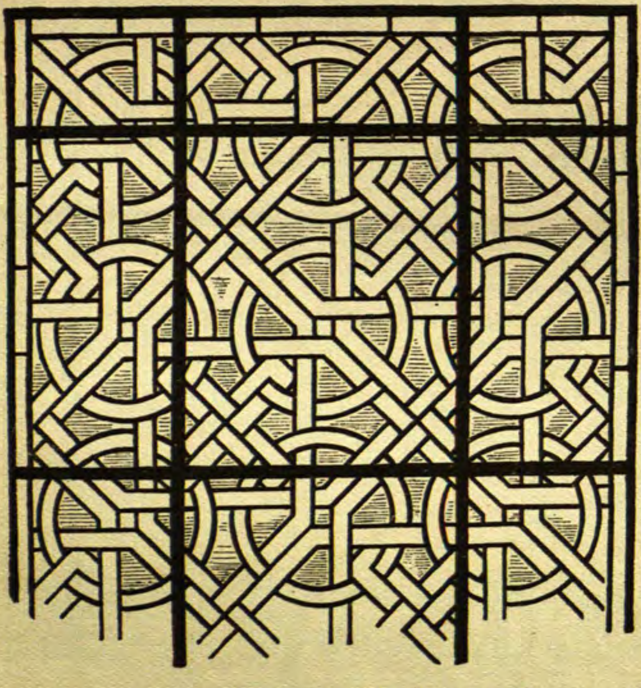
"Hitherto our windows were only covered with canvas. Thanks to you, the sun shines for the first time through them, whereby its golden rays penetrate the divers-coloured panes, lighting up the stone floor of the basilica."

The windows at Egernsee no longer exist and the report of the chronicler is doubtful, for under divers-coloured glass one might understand stained glass, through which the sun would also penetrate. But there is a still older text which establishes the existence of painted windows in the Cathedral of Reims. Rocher, a monk at St. Remigius (968—989), decorated his church and lit it by a window on which manifold scenes were depicted — the Bishop of Reims, Adalberon, wrote. Reims is a French town; Adalberon, however, was a German. The Duke of the Ardennes, a son of Gottfried, was, at the time of his election as Archbishop of Reims, canon of Metz, that is, a town that belonged to the German Empire.

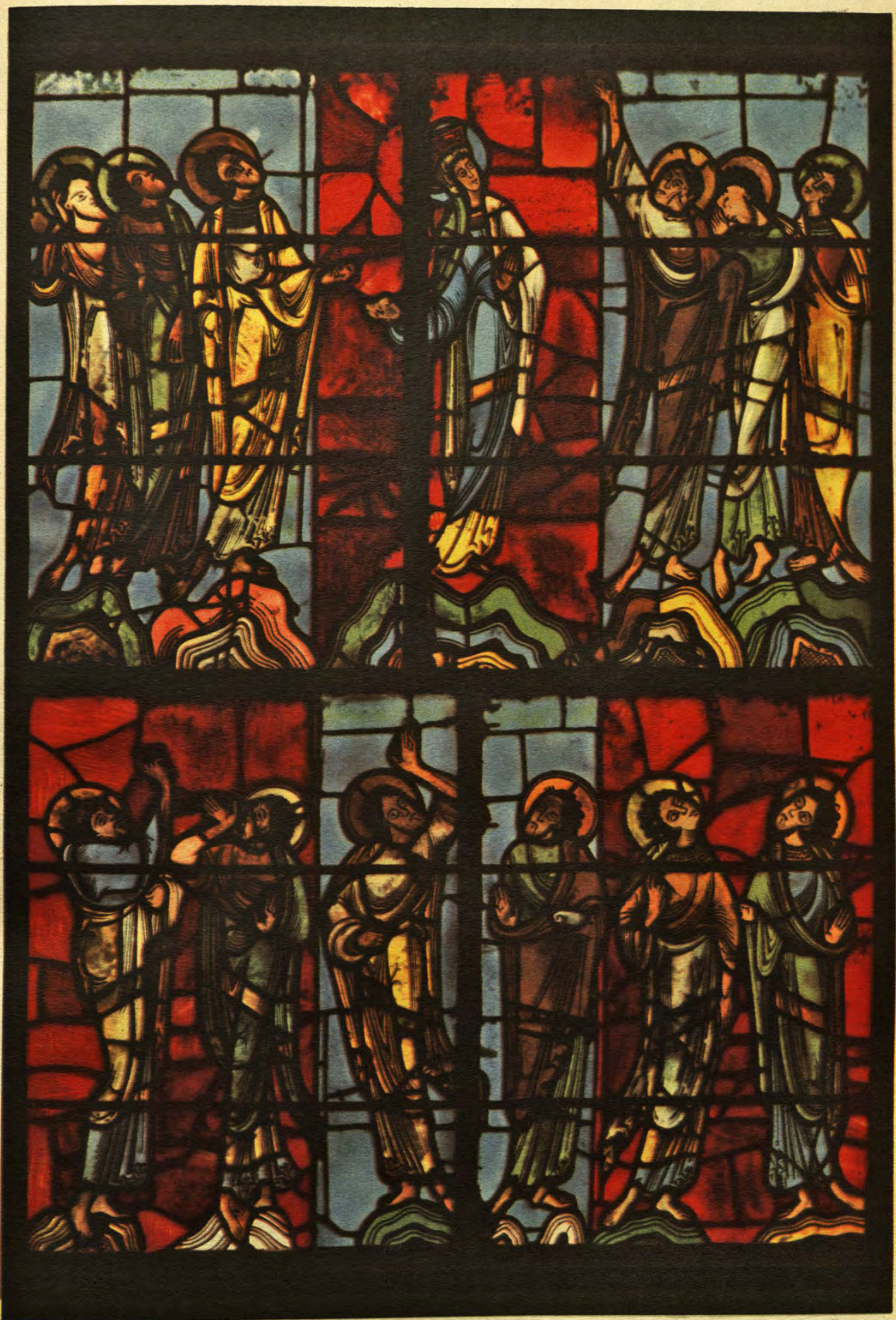
But even if these texts might serve as a proof of the heat method of glass painting, this must have been an art which was still in its infancy and was not widespread; for Labarte again cites a large number of contemporary reports of bishops of all possible cathedrals in which there is no single mention of glass painting. Finally the author capitulates:

"So it must have been in the middle of the eleventh century that glass painting came really into existence. It happened in the Rhine Valley where it was discovered." And to this we might add that Reginhard, the Abbot of the Sázava Monastery, was named as the first expert on glass painting in Bohemia (1162).

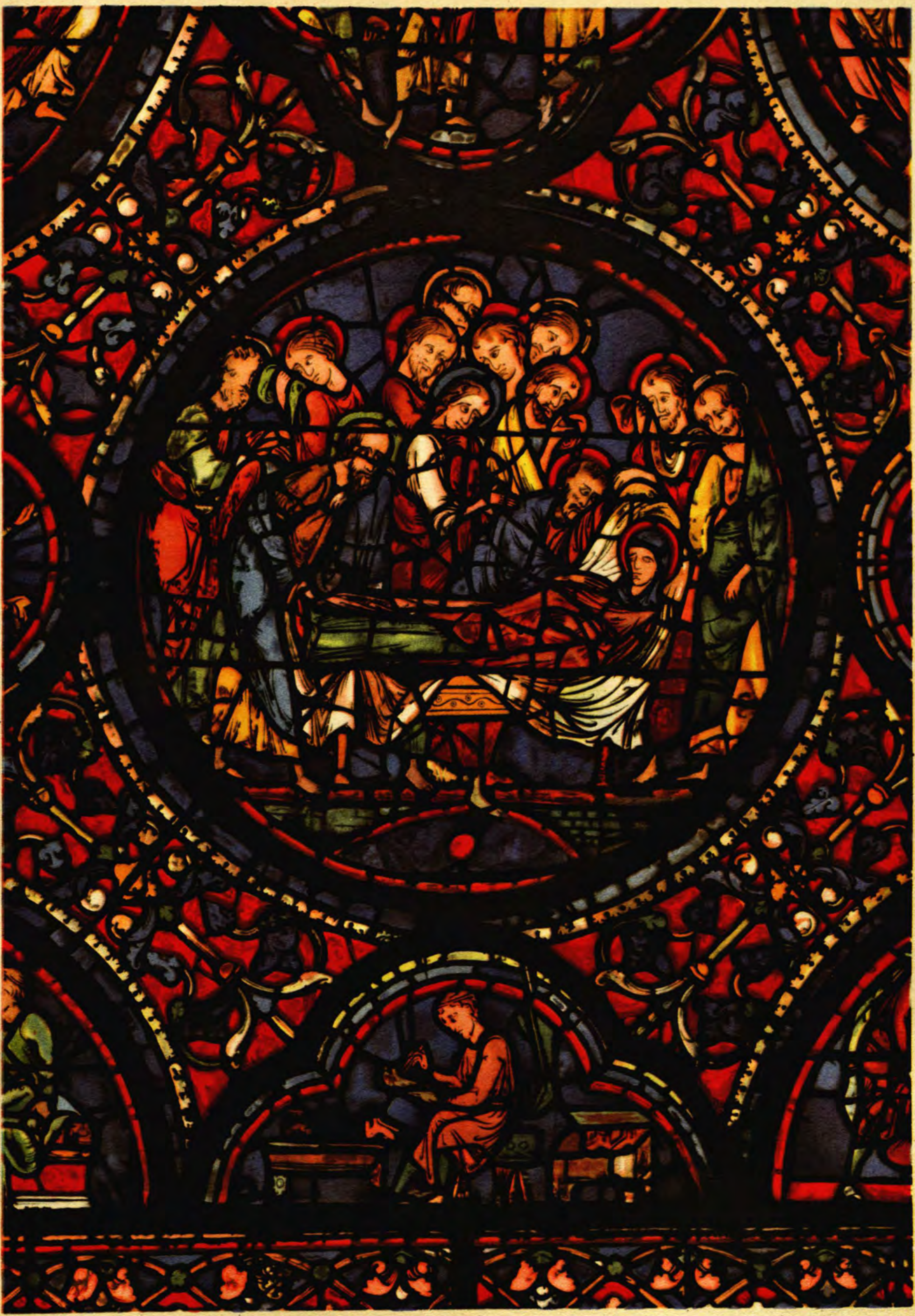
What a detour we had to make before we could return to one of the vital centres of old Roman glass-making: the Rhine Valley, to which we had turned our backs after the end of the fourth century. Glass-making must have continued here throughout this time. The changed social order had, in the meantime, diametrically changed production: quality had been replaced by quantity; the place of luxury production had been taken by tableware of which feudal society demanded an increasing quantity. The slavery of Antiquity had been superseded. Society had become more crystallized and had acquired and perfected production. The reticulated glass of the "Diatreton Vase" and the other luxury vessels had been replaced by ordinary table glass, where it was not so much a question of elegant forms and dazzling lustre as of quantity, since increasingly more people were using glass. As the years went by, this ceased to be a luxury article and finally assumed once again beautiful shapes; that is, a beauty which in com-



75. The window in the church at Pontigny (13th century) is an example of the preference of Gothic and Romanesque art for interwoven patterns in wide, loose strokes with open loops. (Based on Viollet-le-Duc).



COLOUR PLATE XXIII



COLOUR PLATE XXIV

parison with the antique "came from a different world"; as yet feudal society stood still at the beginning of its development and much time was to pass before it felt once more the urge for luxury.

The Technique of Glass Painting

At the age during which glass painting flourished, five types of coloured glass were at the disposal of the artist: red, green, blue, yellow and violet. He painted with a bistre enamel. Theophilus, who at the end of the eleventh century probably witnessed the first tentative attempts at glass painting, devoted the entire second volume of his book on the different arts to coloured and painted glass.

Having discussed glass production in detail, he went on to report the following details about the enamel with which this clear or stained glass was painted:

"Take finely ground copper and heat it in an iron crucible until it turns to dust; then take small fragments of green or Greek-blue glass, each of which you grind between two porphyry stones. Mix all this together, so that the mixture contains one third of copper dust and one third each of green and blue glass. All this is ground once again between two porphyry stones, with the addition of wine or urine. The mixture is then placed into an iron or lead crucible and with it the outlines are traced on the surface of the glass."

Clearly, therefore, the enamel used at the time was composed of copper oxide; for it was prepared in an iron crucible from two fluxes of which one had already been coloured with copper oxide, the other with cobalt oxide. The final result would be a blue enamel as long as the calcinated copper in the iron crucible did not turn into a red oxide. In that case the result would be, not a brown, but a brown-black tone; and in fact, we can see this bistre enamel on many glasses. The recipes also give us a clue to the technology of the time.

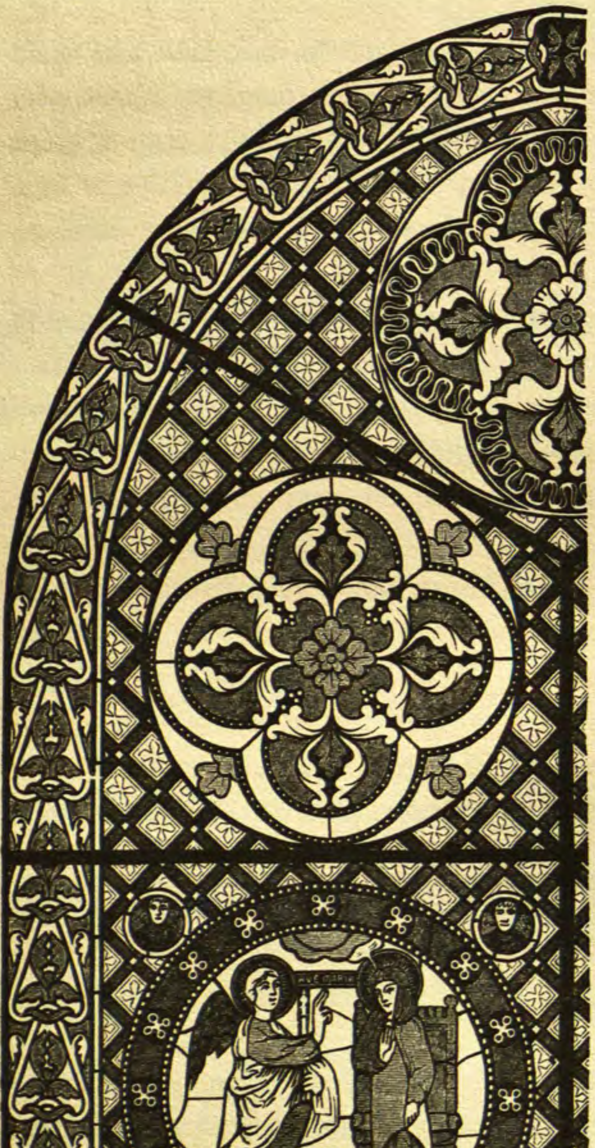
The wooden table was whitened with pulverized chalk that had been dissolved in water. On this the painter drew the exact outline of the glasses or plate-glass with ruler and compass. Having traced these lines with lead or tin he covered them with red or black colour. The same process was applied also to the edges and to the details of the ornament, marking out shadows with hatches such as would afterwards be expressed in a bistre enamel. He noted down the colour of each part of the composition either by colour in each compartment, or with conventional letters which referred to colour. Placing pieces of glass on the spaces they were to fill, he traced upon them with ground chalk the outlines of the design seen through the glass. Cutting glass with diamonds was unknown to the glass-makers until the sixteenth century. The glass was cut with a hot iron wire which followed the lines that had been previously moistened to prevent dissolving. Cut in this way, the glass was rough at the edges and had to be smoothed with a special implement.

Now all the pieces were once again placed side by side on the board and only then did the painter trace the lines and shadows of the drawing with the bistre enamel. Theophilus tells us also how they degraded tones of one single enamel so as to give the effect of three colours. This gives us an insight into the practices of the glass-painters of the time.

As soon as the enamel colour — put on in this fashion — had dried, the glass fragments were put into the furnace. After heating and cooling they were joined with lead. For two hundred years this process, which Theophilus himself had discovered, did not change.

The Development of Window Painting After the Eleventh Century

No painted windows from the eleventh century have been preserved. But in the Cathedral at Angers we possess some from the twelfth century. They are a gift of Bishop Ulger (1125—1149). There are further fragments from this period in the St. Sergius church and in the Hospital Chapel in the same town. Some glass panes which, according to his own report, Abbot Suger (1122—1152) had placed there, are still preserved in the apse of the Old Abbey church in St. Denis. He had himself immortalized on them, kneeling in front of the Holy Virgin. In Chartres, in the west rosette of the Cathedral, there are also three beautiful windows whose brilliance — in Lassur's opinion — outshines all others with which the cathedral was later decorated. The Trinity Church in Vendôme has a window which represents the glorification of the Virgin Mary; it has been reproduced by Lasteyrie.



76. The window in the apse of the monastery church at St. Denis shows the maturity of French art at that period. (First half of 12th century.) (Bucher)

These twelfth century windows are composed of small medallions, each of which bears a different decoration. Together they form a regular mosaic of stained glass. The background is formed by square or reed-like patches which are filled with four-petalled blossoms, clover leaves or other shapes. They are set into a most colourful frame of intricate foliage and palms.

The pictures on the medallions are taken from the Old and the New Testament or from the stories of the Saints. They are moving in their simplicity, without detriment to life and movement.

The main lines of the drawings are traced with lead joints which link the different stained, not painted, pieces of glass. On these tiny fragments the folds of the robes and the details of the ornaments are painted with a brush in a bistre colour. The background is formed by faintly violet glass.

Already in the thirteenth century this process was changed. Without foreign interference the characters of the depicted persons and objects changed. Frequently only grey glass — through which light penetrated more easily — was used in the place of the earlier dark glass. The grey glass served as a frame; its monotony was sometimes livened by stained glass. Many French, English, Spanish and German churches can be named which have thirteenth century windows.

During the fourteenth century the appearance of the window panes changed considerably. The standard of painting rose. The glass painter emerged from his humble position and tried to imitate nature, often with success. He was already searching for chiaroscuro and used light and shade for ornaments and drapery. He even painted with grey colour on white glass. In the middle of the century the discovery of the gold-yellow shadings was made.

The new enamel consisted of a heated, ground ocre that was mixed with silver sulfide. The pieces of glass were heated with the mixture, then the ocre layer was removed and on the glass there remained a more or less intensive shade of yellow; in fact, according to the amount of gravel used, a yellow mordant. In this way the painter gained a second wonderful colour which he could frame in lead, render down and use in a combination with grey and gold. This progress made finally possible the secular use of this art, which had been hitherto a Church monopoly.

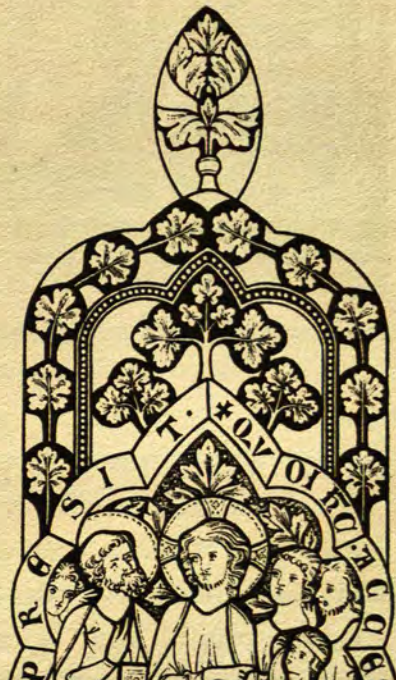
Under Charles V, the Paris Louvre and the St. Paul Building received painted windows. The religious motives gradually gave way to secular ones, taken, e. g., from the love novels of the time. At least, so we are told in a poem from the time of Charles VI of France. Many windows from this century have been preserved, acting as proof that the motherland of glass production had been far outshone by the rich West.

Strangely enough, the fifteenth century enriched the glass palette only by one colour, called "umber", a flesh colour made from iron oxide. Its faint shade is difficult to distinguish. To these colours must be added further the combinations of thin glass panes, stuck one on top of the other. To meet the requirements of the design red glass was used here and there, making the white glass beneath it stand out.

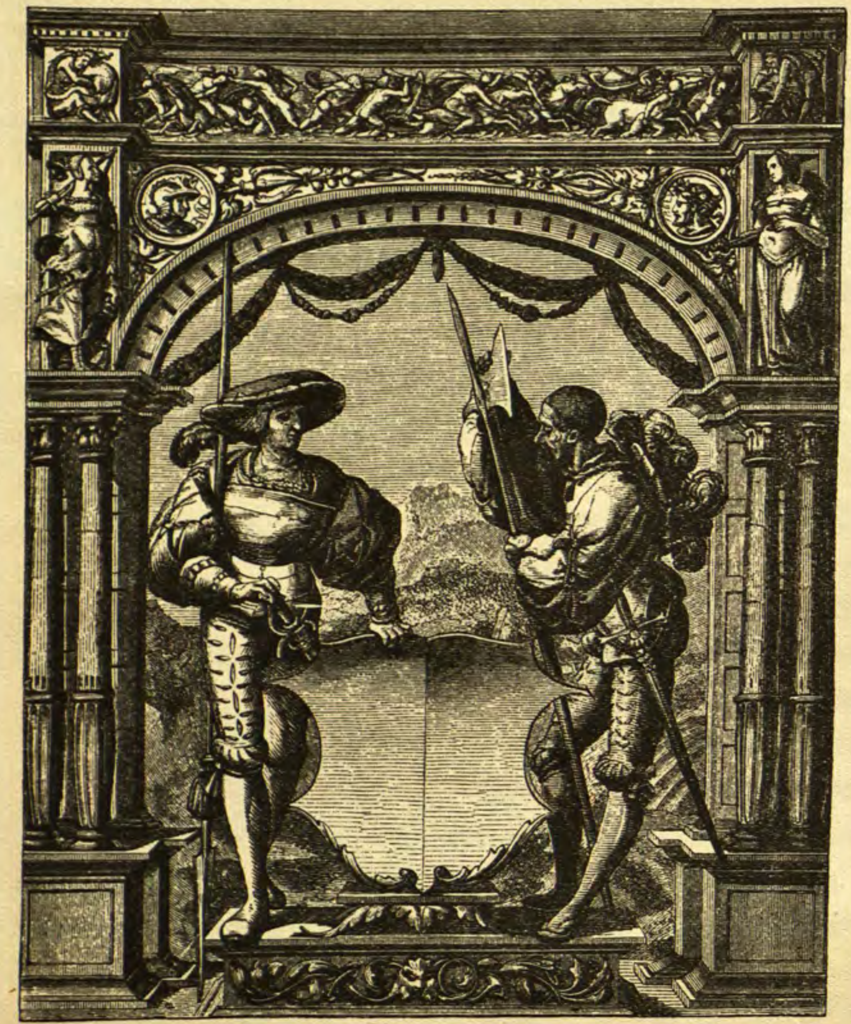
Towards the end of the century a new method of mixing colours came into use. The glass-maker took a further colour of glass with his blowpipe: he could repeat this several times so that finally a single glass lump had different coloured stripes. Such glass gave new tones and manifold effects to the windows. When the painter wanted to represent, for example, the coat-of-arms of the French kings — three lilies in a light blue field — he would take blue glass with white-plated glass, cut the coat-of-arms from the blue layer and colour the white lilies yellow gold. When he then took all the pieces out of the furnace the three colours had been fixed. The glass-makers achieved a new green by firing transparent, yellow enamel into blue glass. To avoid a fusing of the colours, they placed the untreated surfaces on top of each other.

As painting developed during the fifteenth century, these mosaic windows were replaced by larger picture compositions in which grey became the predominant colour. This century is the Golden Age of glass-painting. The authorities of Santa Maria del Fiore invited master Franz von Lübeck, the most famous painter of the time, to decorate the windows. The largest windows in York Minster also originate from this period.

The first third of the sixteenth century brought no substantial innovations in this art, but towards the end of the year 1540 a new enamel, namely iron-red, was discovered which was used for the first time in the church of St. Gudula in Brussels. Only a few years later new colours followed. Roughly at the same time in Limoges metals were covered with a similar enamel; and not much later the cutting



77. An example of the details of the ornaments in the Nunnery at Klosterneuburg near Vienna. About 1300. Treated like a medallion window. (Based on Camesina.)



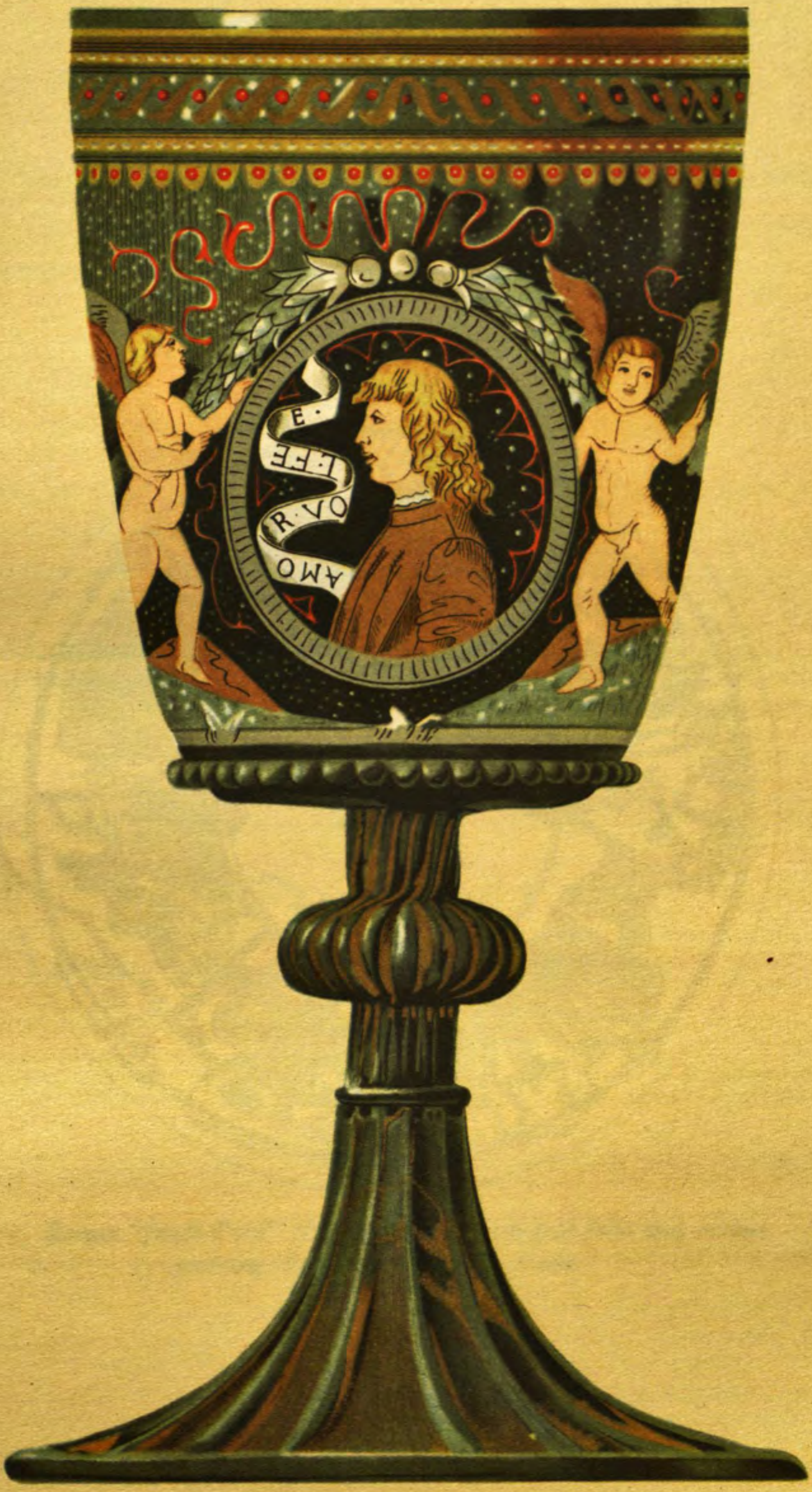
78. Renaissance glass-painting from the 16th century by H. Holbein the Younger. Basle Museum. (Based on Woltmann.)

power of the diamond was discovered. At that time the first lead wire manufacture was opened which substantially lightened the glass-maker's tasks. The extending colour scale enabled the artists to dispense with the mosaic technique and, instead they painted with different colours on white plate-glass.

At the end of the seventeenth century the fire under the muffle furnaces of the window-glass painters went out. But they were lit again in the nineteenth century, even if by different people and in a completely different form. M. Brongniart did so, when he was appointed Director of the Porcelain Manufacture in Sèvres, and in the neighbouring countries this art was also revived.

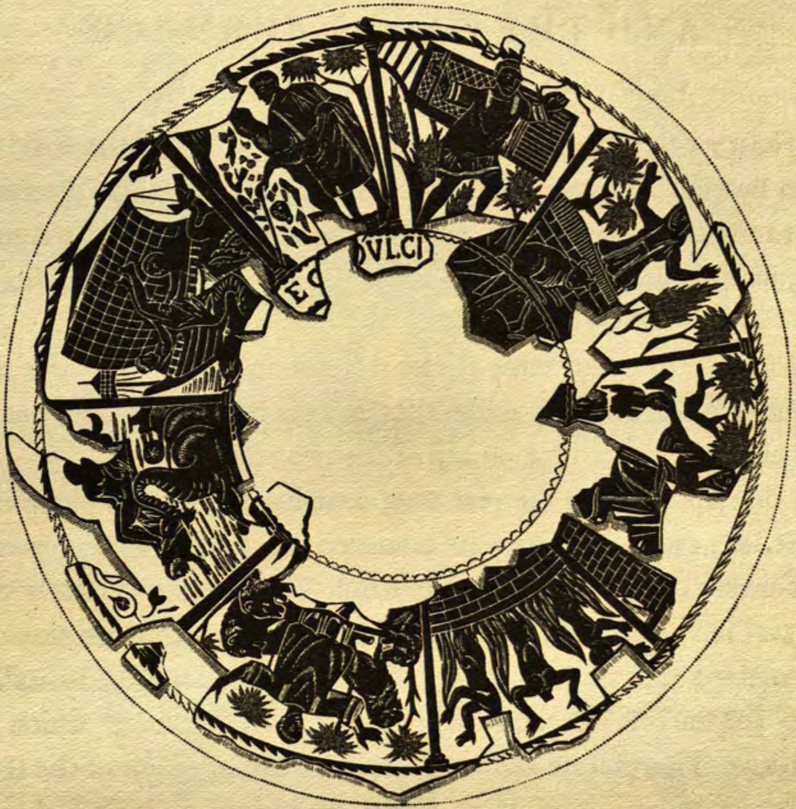
Citing Labarte, we have spoken exclusively about French window painting, as if it had not existed in Bohemia, Austria, Germany and other countries. For none of our old windows have been preserved, and so it is not our good fortune to possess such complete records as the French technical literature. When Abbot Reginhard of the Sázava Monastery painted glass as early as the year 1162 — "fuit non ignarus artis et omnis, quae ex vitro fieri solet, compositionis" — he cannot have been the only one and must have had disciples; for already in the year 1267 the St. Vitus' Cathedral in Prague had two windows painted with figures. Only fragments have remained of Bohemian medieval windows. Those comparatively well-preserved bits in the church of the Holy Mary in the Charles Court in Prague originate from the beginning of the sixteenth century. Extensive excavation and research in Bohemia will certainly surprise us with new discoveries.

The two most precious windows of the cathedral at Erfurt, Thuringia, which undoubtedly date back to the sixteenth century, show an indisputable connection with Bohemia. Even though the original interpreters of these windows made efforts to cover up this relation, they had to admit that the window which represents scenes from the first book of Moses (the so-called "Genesis Window") corresponds directly to the art fostered at the court of Charles IV who in the year 1376 resided in Erfurt. A further connection to Theodoric of Prague and the Hohenfurt master is unmistakable. On the other hand, the so-called "Passion Window" contains certain characteristics of the workshop at Markterlebach near Nuremberg. This workshop was in direct artistic contact with the Austrian and Bohemian cathedral workshops. More recent research has supported this connection and enlarged it so that today the cathedral guide speaks already of eight windows which are obviously of Bohemian origin.



COLOUR PLATE XXV

It is, hence, less surprising that a Bohemian original is indicated also in the altar window of the cathedral at Meissen, which was not only a cathedral, but also the court church of the Saxon rulers. For us, this cathedral is all the more memorable, because here the daughter of Bohemia's most popular king, George of Poděbrady, Zděna, lies buried under a bronze slab made by Peter Vischer's Nuremberg workshop. Her portrait is said to have been Dürer's creation.



79. Roman "fondi d'oro" plate, decorated with gold folio and enamel painting. Reproduced from F. Slade.

80. Old French glass from Normandy. Reproduced from Gerspach.

THE CHANGES IN THE MEANS OF PRODUCTION AND THE GLASS FURNACE

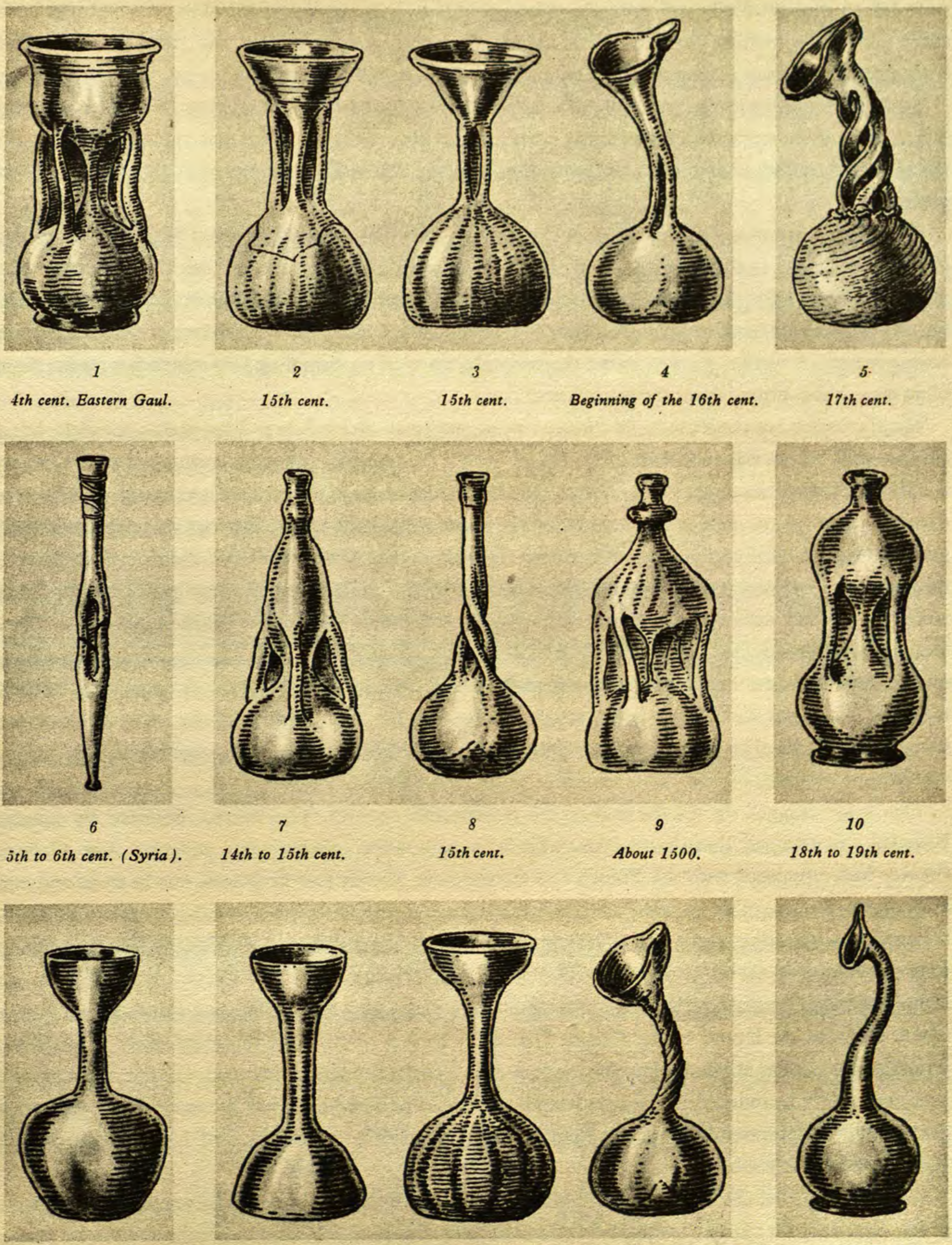
UNTIL THE SEVENTEENTH century the glass furnaces of feudal times did not differ very much from those described by Heraclius and Theophilus. As a result, Agricola's famous description repeats almost word for word the same facts. As in Antiquity so also in the Middle Ages it was necessary to melt the glass twice; for only during the second phase did the mixture change from a raw material into useful glass.

The late medieval furnace also had three sections: in the first, the "frit" was melted, in the second — the most important — it was purified, and in the third the finished product was annealed. This third section was situated either by the side or on top of the two others.

Rabanus Maurus' description from the year 1023 contains a miniature picture of an early medieval glass furnace. To the left, the glass-maker sits crouched, busy cleaning the crumbled, broken "frit". On the right, a glass-maker is sitting, blowpipe in hand. The fireplace is clearly visible. Further right, the "frit-oven" (calcar) is visible. Above the hearth, from which through three openings flames are blazing, there is the melting furnace with the pots and below the roof, the annealing lehr.

In the year 1340 Johann of Burgund published a travel account which contained a picture of a medieval glass-house. This picture shows a horizontal arrangement of the three furnaces.

The mayor of Chemnitz (now Karl Marx-Stadt) in Saxony, Georgius Agricola, in the twelve chapters of his work, published in 1556, gave close information about the mining industry and about the glass-houses of his age. In a typical German fashion he did his job most thoroughly. He began with a calcar, which ought to be 6 ft. long, 4 ft. wide and 2 ft. high. Here the glass was melted, until it became a turbid liquid. The pots were warmed in advance. The hearth is at the bottom of the furnace. One picture shows the outside of the furnace in the foreground and in the background the same furnace without the outer walls to reveal its inner arrangements. The fire chamber is at the very bottom and on its left side there is the hearth. The actual place in which the glass was melted in the pots was above this; their arrangement corresponded to the individual "workholes" just as is the custom today. Above this furnace, there was an annealing lehr which availed itself of the heat of the melting furnace through a square aperture. To the right, there was the mouth of the furnace into which the earthenware pots were placed which contained the finished glasses. They



1
4th cent. Eastern Gaul.

2
15th cent.

3
15th cent.

4
Beginning of the 16th cent.

5
17th cent.

6
5th to 6th cent. (Syria).

7
14th to 15th cent.

8
15th cent.

9
About 1500.

10
18th to 19th cent.

11
3rd to 4th cent. (Syria).

12
14th to 15th cent.

13
15th cent.

14
Beginning 16th cent.

15
17th to 18th cent. (Persia)

81. The historical development of the shapes of the so-called "Angster" and "Kuttrolf" glasses. Supplement to the work by Franz Rademacher.

were left to cool gradually and properly to even out the inner tension of the glass that had just been taken out of the melting furnace. Without this slow process of annealing the glasses would never have stood the sudden displacement of the molecules and would have broken.

This picture shows us that Agricola's furnace had no special section for fritting the mixture, so that it had either to be worked simultaneously with the raw glass, or that the frit was melted together with the glass; of course, in two phases. A second picture by Agricola shows the activities of a medieval glass-house.

Workers are shown at different phases of their customary work around the glass furnace. The master glass-maker, sitting in the foreground, complains to his wife that he had earned little that day as a result of extensive breakages. In the background, a man carries away the finished products in a wicker basket. On the left-hand side of the picture, there is a resting room in which the workers are drinking from large pitchers. A further picture shows the vertical section of an annealing lehr which has no fireplace of its own, but is heated from the main hearth.

The dimensions of these medieval furnaces were very small. According to Theophilus, the right-hand furnace wall, which was subdivided, was altogether 3 × 5 m. Agricola's measurements are a little larger. Melting took place in earthenware pots to whose production the greatest care was devoted. This was a highly esteemed art. The pots were dried in the shade for a long time before use and then only used gradually and carefully in the annealing lehr that they might withstand the varying high temperatures at a later stage without harm, for a long period. The shapes of these pots varied. Some were shallow and dish-shaped, others belly-shaped, sometimes with curved or indented edges. They were on an average about 60 cm high and calculated to hold 80—100 kg of glass. The composition of the glass mixture did not change throughout the whole Middle Ages. By using exclusively local raw materials that were easily accessible, the already low quality of the glass deteriorated even further. The glass was greenish and brownish in colour, usually badly melted, full of stones and lumps; in short, a glass which needed to be covered with painting.

This stage dragged on till the end of the seventeenth century. The furnace depicted by Johann Kunckel still retained this shape. Kunckel's furnace, however, shows some progress. The *German* furnace had, compared with the French and Italian ones, already two fireplaces, one in front and one at the back. But even this German furnace had no grates so that the type of heating, called "German", was still very imperfect and much of the precious fuel was wasted. The lack of fuel began to make an impression even on the conservative brains of the glass-makers, where it had a devastating effect. In the dungeons of the Prague Castle "Necessity taught Dalibor to play the fiddle", as a Czech proverb runs which refers to the legend of the Knight Dalibor. The lack of fuel had the same effect in England, where coal was close at hand. Here for the first time a coal grate was introduced. On the continent the first grates were introduced in the seventeenth century. The *Bohemian* glass furnaces, developing such grates quite independently from the English, made possible a central form of heating. The *French* furnace had a side grate.

But coal increased the impurity of the glass. And so, until the invention of the regenerative furnace, it was used only for cheap consumption glass, never for fine luxury glass which continued to be manufactured with wood fuel. In England they overcame this difficulty by using closed pots for melting lead glass.

Otherwise the glass-houses continued unchanged. Their light, transportable structure was determined by the continual moving from place to place in search of fuel. The smoke escaped only through the side windows until 1800, when chimneys were introduced into the roof.

The Shapes of Hollow Glasses

At the beginning, the most wide-spread glasses were low cups, originally with a narrow bottom. Only much later were they given some stability by the perforation of the bottom. In Germany, these were called "Maigelein" glasses.

Such a cup, resembling in size a closed fist, had a smooth surface in the early Middle Ages; later the glass-makers endeavoured to beautify its appearance by adding ornaments in waved, spiral or reed-shaped engravings. Apart from the "Maigelein" glasses, soon other vessels were being made which were easier to hold since they had either circular rings or protruding bulges. These were the so-called "Krautstrunk" (or "cabbage-stalk") glasses which, in the course of years, were perfected by the addition of an indented, curved stem and a special snout. Some manufacturers tried to improve these vessels by adding various ornaments. The beakers from the Frankish period had neither stems nor feet (and therefore their contents had to be emptied at one draught); any occasional stems or feet were too small to guarantee steadiness. The manufacture of "snout beakers" — so widespread in Antiquity — was very difficult in the Middle Ages.

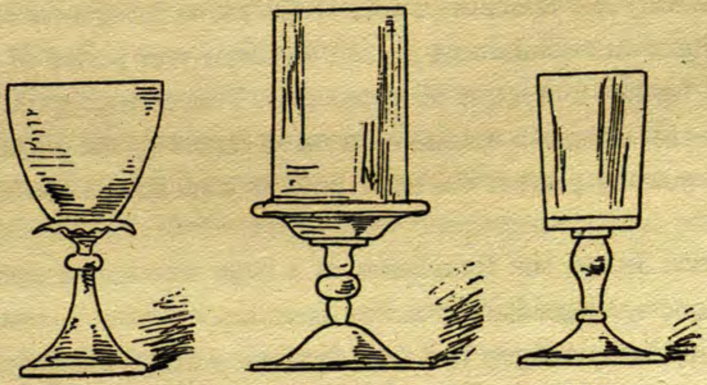
A further type of glass were the delicate, cylindrical "Spechter" glasses out of which the "Pass-glasses" developed. These were used during the ceremony of knighting somebody to the nobility. Their outer walls were encircled by wheeled stringing in the form of rings, set at regular intervals, and the contents between such two rings had to be emptied at one draught. These glasses were fairly stable and their appearance richer.

A vessel, called "Igel" ("hedgehog") was widened to a bowl at its upper end. The medieval mass chalice — resembling the crater of a volcano — was provided with two handles.

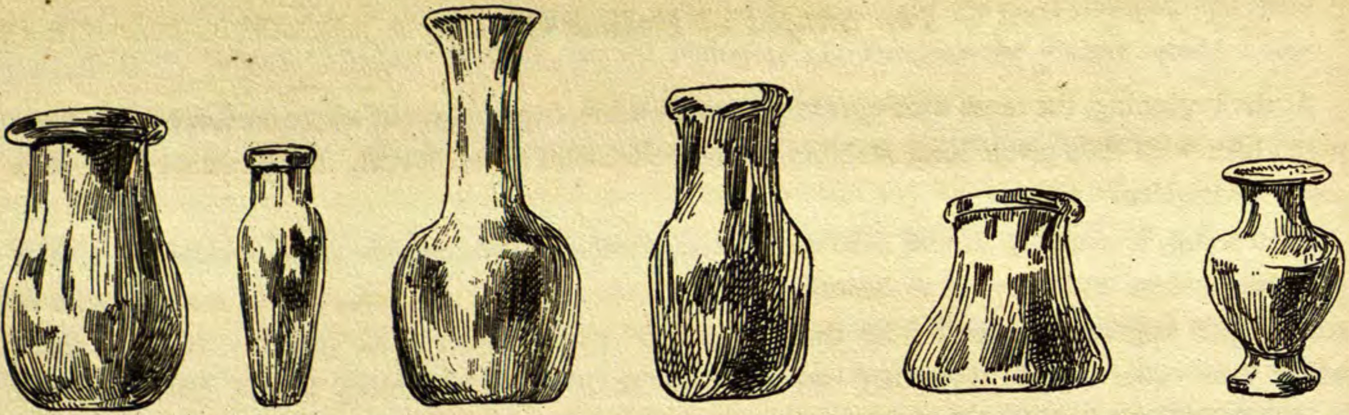
From the "cabbage-stalk" glasses the so-called "Rummer" ("Römer") glasses developed in the fifteenth century. These were some of the most distinguished drinking glasses of the vanishing Middle Ages. After various transitory forms the shape crystallized which even today bears witness of its popularity.

These few shapes characterize the entire medieval development of hollow glass. It clearly meant a decline.

During the early Renaissance the German glass reached no higher level. Out of the bulbous-shaped cavity tubes like windpipes intertwined, uniting at the top into a snout. Such impractical vessels could be used only for careful and slow drinking. Similar odd shapes often caused great mirth during drinking. Even animal-shaped and boot-shaped vessels existed. Jugs with handles corresponded in shape to the earthenware jugs.



82. Celtic drinking vessels, based on Gerspach.



83. Glasses from the Langobardian treasure of Queen Theodelinde at Monza near Milan, from the 6th cent. Reproduced from Gerspach.

WEST EUROPEAN GLASS-MAKING ITS MEDIEVAL BEGINNINGS AND ITS DEVELOPMENT IN MODERN TIMES

Altare

It has already been stated that the Golden Age of West European glass-making ended with the fall of Rome. For centuries glass-making in the West existed only on a very low level. Orientalists today doubt whether the medieval glass-houses, e. g. in Spain, really needed the help of the Arabs; they may have been the direct descendants of the Iberian glass-houses of Antiquity.

In France, too, the fires of the glass furnaces were not altogether extinguished. In the twelfth century glass-workers emigrated from Normandy to the North Italian township of Altare near Genoa, in the Dukedom of Montferrat.

Here they formed the strangest of all medieval glass companies: "Universita dell'Arte vitrea" (a University of the Art of Glass-Making). This was ruled by two Consuls who were chosen from among the best glass-makers. After the year 1490, their constitution was acknowledged by the lords of the land. In this "Regula" the working period was strictly limited from St. Martin's to St. John's. There were laws dealing with the acceptance of strangers as well as the punishment for breaking the decisions of the consuls. New consuls were elected by this "Company" every six years. Applicants for membership in the community had to deposit a sum of 300 lira or its counter-equivalent in real estate. Entry into the community meant committing oneself to a four-year period of work (as, for example, the Czech Schürer) and further four years of instructing. This strange guild was strictly organized and distinguished itself — for unknown reasons — from all others by the peculiarity that its members went out into the world year by year; it was their duty to work in the world and then to return to *Altare*.

This periodic emigration led to the foundation of a large number of glass-houses, for example, in Nevers, Lyon, in Flanders, Liège, Paris etc. But from time to time — usually once a year — the emigrants returned to Altare where many had their families. Abroad, too, they lived in close communities which maintained regular contact with the consuls. It appears today that the mother community gained knowledge of methods and technology through these travels which otherwise they might never have acquired.

Altare was the very extreme opposite of Murano. The laws whose infringement flung the Venetian glass-makers into the lead chambers of the Doges' dungeon, were not valid in Altare, and, vice versa, the laws of Altare were not valid in Venice. Yet it seems that abroad the craftsmen of these places often co-operated.

France

During the Roman period a large number of small glass-houses were typical for Gaul. These were situated in the proximity of fuel usually, and in most cases they satisfied the local requirements. This glass for local consumption did not suffer the disturbing influence of the fall of the Roman Empire and continued to be produced at the times of the Franks and the Merovingians, even if its quality, as in the rest of Western Europe, suffered considerably.

On the whole, we know little of these events; there were two places where glass was being manufactured in Normandy, of which the better glass was called "Damascene".

It must, however, be assumed that the gold-decorated beakers which the German Emperor Henry II presented to the Abbot of Verdun, in the year 1002, originated from the East. We are told that in the eleventh century William the Conqueror used glass at the Easter meal. Philippe of Valois' table is said to have been decked with glass when he entertained the four Emperors: John of Luxemburg (King of Bohemia) and the Kings of Scotland, Navarra and Mallorca. Equally Charles V, the Wise, is said to have feasted Emperor Charles IV, the King of Bohemia, on glass vessels.

A monastery chronicle from the year 1250 mentions glass mirrors and the rules of the Paris guild in 1260 forbade the production of glass jewels because the customers were deceived by these. At the end of the thirteenth century there is a mention of a glass-house at the right bank of the Durance river. It lies suspiciously near the Italian border, and therefore it is no wonder that it was managed by Benedetto Ferro who came from Altare. Elsewhere, it is stated that the altar at Westminster was imported in its entirety from France. Only in the fifteenth century is there any mention of glass-houses in other regions of France, e. g., Poitou and Limousin. The inventory of King Charles V mentions also glass-houses in the northern Pyrenees, in Normandy, in the departments of Bordeaux and Nivernais; the latter region was the only lowland area which was thickly afforested. In the neighbouring Belgium as well as in Champagne, glass is mentioned for the first time in the year 1577. Since the French fifteenth century products have many common features with the Rhine-valley glass, close co-operation of these two age-old glass-producing areas can be assumed, although we know nothing more about this.

In the sixteenth century glass-making started in Britanny, introduced there by immigrants from Altare. The circle was closed. From Normandy to Altare and from Altare back to Britanny. Glass developed independently in Normandy because the country did not belong to France for a long time. In the chronicles exclusively German names appear which were replaced by purely French names only in the fourteenth century. Finally, it is interesting that the Norman masters re-invented glass moulding in the seventeenth century, in the very century when competition started with Italian and Bohemian glass-makers.

The unsurpassed glass windows of the French cathedrals have already been discussed in a separate chapter. All this contradicts the assertion that France had no glass production at the time when the earliest windows made their appearance. We must take chroniclers' records with reservations.

Dutch, Flemish and Belgian Glass

The history of the area now called Holland and Belgium links up with most European countries. They formed part of that Holy Roman Empire whose backbone was formed by the German people; but they were many times under French rule. The Burgundian dukes supported the Arts there and the Netherlands flourished until they fell to the rule of Spain at the time of Philip II, when they came under the Habsburg yoke. Finally, in 1795, Flanders, with other parts of Belgium, was joined to the French Republic. After the Congress of Vienna, Belgium and Holland were united into the Kingdom of the Netherlands, from which, fifteen years later, Belgium liberated itself.

Since the glass-makers in old times moved from town to town, district to district in this area, it is today extremely difficult to separate the Belgian from the Dutch glass, especially since also Venice and Germany constantly influenced glass-making there.

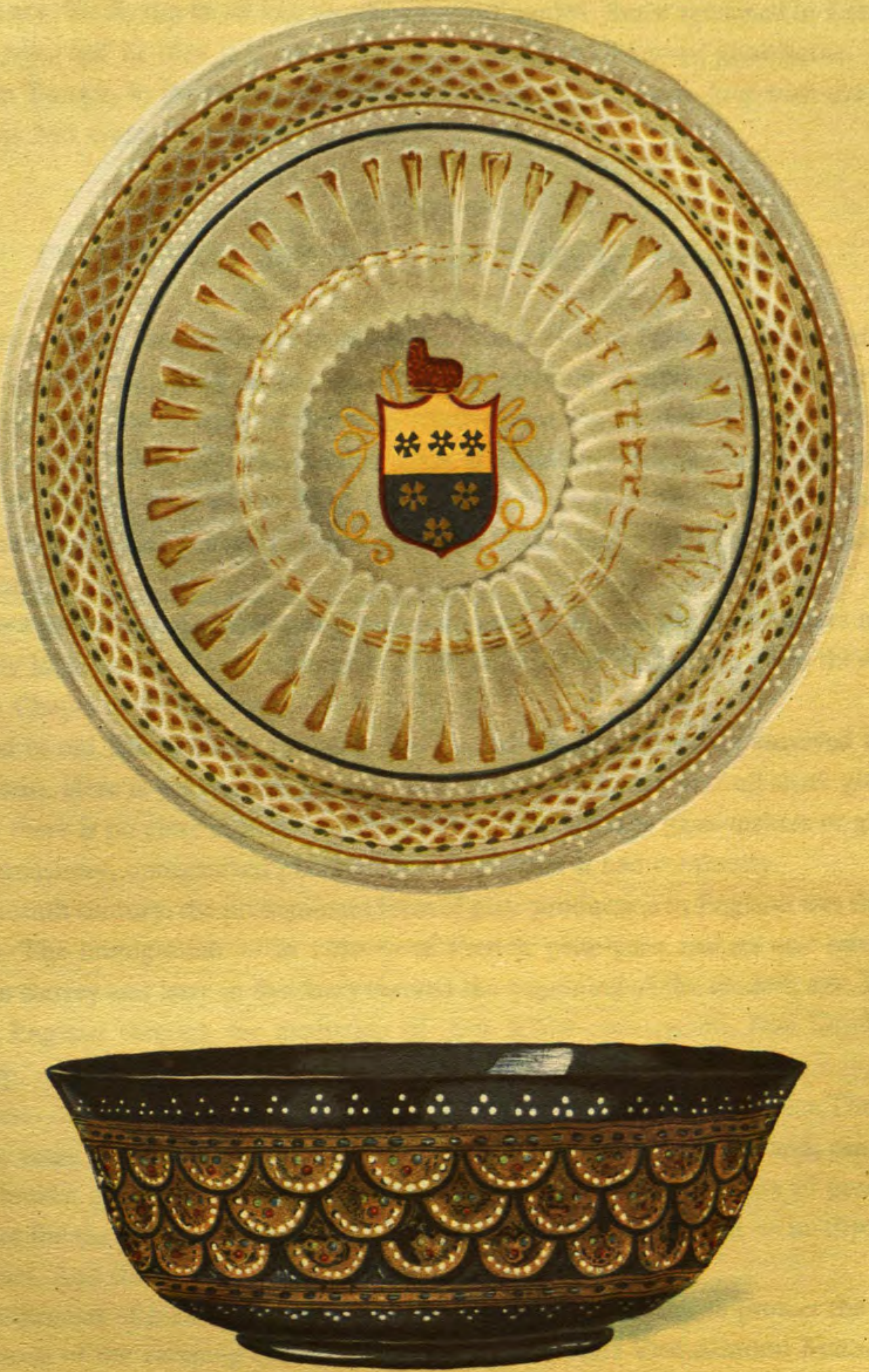
The oldest records about Flemish glass are contained in the inventory of Charles V of France from the years 1380 and 1421; there is a mention of a glass-maker at Namur. In 1485 an English record mentions the import of Netherland glass into England. In 1503 a mirror factory was set up in Flanders; and in the same year the Venetian City Council permitted the Gallo family to set up a mirror manufacture under a Flemish name. From the same century legal records have been preserved about a dispute between Dutch glass-makers, one of whom was the first to make a microscope. In the jewel list of Margarethe of Austria from the year 1523 a large beaker with lid and silver stand is entered. Today it is in the National Museum in Amsterdam. Not only business, but also family relations between Flemish and Venetians glass-makers are mentioned and in the sixteenth century Antwerp, Brussels and Liège were the main sites of Netherland glass production. The relations between Ligurian Altare and Flemish glass are quite evident.

The outstanding contribution of Dutch glass-making is their invention of glass "stippling" with a diamond point and also their glass engravings. Mainly women carried out this work, even ladies of high society who considered this extremely wearisome occupation a pleasant entertainment. Highly artistic pieces were made, among which the most famous were the products of the bishop's glass-house at Liège. From an artistic point of view no less significant are products beautified by diamond cutting. At the time when Belgium fell under the rule of the Habsburgs, the Bohemian method of glass engraving was becoming known in Flanders; consequently the English glass-houses sent large quantities of raw glass to Belgium, since otherwise they would have been forced to send these all the way to Bohemia to have it engraved in the famous Bohemian method.

Spain, Portugal, Mexico

Just as in other provinces of the Roman Empire, so also in the Iberian peninsula a glass tradition continued, but there is no authentic proof as to whether it survived the invasion of the Germanic tribes. Undoubtedly, glass-making was revived much sooner in the areas in which the Arabs settled than in Barcelona, where glass-houses are mentioned only in the fourteenth century. Under the Oriental influence the glass-houses in southern Spain closed down gradually; those in Catalonia kept their high quality for a long period and their products during the eighteenth century were exported to the entire world where their popularity ranked side by side with the Venetian glass.

On the other hand, we have records of Portuguese glass only after the seventeenth century when we



COLOUR PLATE XXVI

hear that Italians from Murano and Altare as well as Flemish workers were busy there. The glass-houses must have been highly productive and supplied the entire local market. This is clear from reports by Bohemian glass merchants from the year 1739, since they complain of the Portuguese authorities' ban on the import of glass-ware.

An organic part of these glass-houses was the one in Puebla in Mexico, which was a branch of the Iberian glass industry. We do not know exactly when it was founded. But it remained in Latin America for two hundred years and in 1648 it is referred to as an already well-known glass-house. It was traditionally rooted in Europe, in the country in which the fusing of the Roman-Arab with the Byzantine-Venetian traditions had created a harmonious entity.

Great Britain and the United States of America

"There is simply no proof that there was glass production in Britain from the sixth to the fifteenth century," Albert Hartshorne wrote in his detailed and certainly comprehensive history of "Old English Glasses" (p. 131). But in spite of this authoritative assertion he related that in the year 1230 a glass-maker (Laurence Vitreanus) was melting glass at Chiddingford; and that the inventory of Henry's assets — the second-born son of King Edward I (1268—74) — mentioned a beaker which is said to have cost two and a half pence. This low price is a likely clue to the fact that it had been produced in the country.

Further there is a proof that the Abbot of Wearmouth sent to France for glass-makers in 675; and in 1350 sufficiently large sheets of colourless glass could be made in England to glaze the windows of the St. Stephen's Chapel at Westminster.

The glass found in old Saxon tombs probably was English-made glass which survived the Roman occupation of Britain. Here is yet another realistic note: in the Colchester tax-roll three glass-masters are entered — but there is no clear indication whether they were actually glass-makers or glaziers, and whether it was a transitory, unorganized phenomenon or whether it had continuity.

Later in the sixteenth century, the predominant form of glass production in England was the Venetian and French form. The immigration — in 1570 — of French plate-glass makers and mirror-makers who settled first in Surrey and later in Salisbury marked the beginning of the modern era. They came, it is reported, to England through the mediation of their fellow-countryman, Jean Carré, who had settled in Antwerp.

The lack of forests caused the glass-makers literally to be chasing from place to place. Their wanderings, which usually came to an end in the densely forested areas of Scotland or Ireland, can still today be traced by the broken glass furnaces and piles of fragments. Finally the necessity of preserving the already scarce trees for the more important construction of a fleet led to the ban — in 1650 — on the use of wood for fuel. And the only remaining alternative was to use coal.

At that time the process of melting in closed pots was introduced in order to protect the glass from the harmful influence of the escaping coal-gas. For about thirty years Vice-Admiral Mansel held the monopoly of glass-making, and he was followed by the Duke of Buckingham, who, thanks to his influential position at the Court, fought against the import of the incomparably better glass-ware from abroad. But already at the end of the seventeenth century there were eighty-eight glass-houses in Great Britain and in the following century glass production made tremendous strides, both quantitatively and qualitatively. The English glass-makers of the period devoted themselves almost exclusively to the production of goblets and dishes which were in far greater demand here. Many factors caused this: In this country industrialization was far ahead of the rest of the world; club life — quite unknown in other countries — was already flourishing; the taverns and inns, which rose in England long before anywhere else, proved constant consumers; the wealth of the economically rapidly developing middle classes was quickly increasing. All these phenomena were quite unknown on such a scale in the rest of Europe. The rising purchasing power of the founders of primitive capitalism led to customs which did not develop elsewhere; e. g. to the tradition of using different glasses for each sort of wine. Soon they learnt to mix the imported wines with different kinds of distillates of local origin; from this the typical Anglo-Saxon cocktail disease arose which, again, called for a large number of new variants in glasses which were more beautiful than practical.

The lively society life stimulated the large-scale production of chandeliers and candlesticks. Finally, the growing colonial Empire opened up large overseas markets for the young English glass industry, especially the North American continent. Sales were ensured through tariffs and other means which Great Powers manage to enforce on dependent countries. The most famous glass of the time is the Bristol and Nailsea glass. There is also a mention of glass from Ireland (Waterford and Cork).

We shall speak later about English lead glass, but it seems not out of place to mention this here. Robert Schmidt wrote:

"The epoch-making English invention of lead glass came at this time. Though the addition of lead increased the weight and the whiteness of the material, it gave the glass an absolute transparency and a hitherto unknown, magnificent lustre. This shows itself particularly when the facet-cut broke the light and reflected it." Ch. Merret stressed in his notes to Neris' work "Arte Vetraria" (1662) that lead glass was not used in England; but already in 1680 the Bonhommes in Liège produced "flint glass à l'Anglaise." The name "flint-glass" is not the determining factor; it was taken over for the newly invented lead-glass. In Germany the expression "crystal-glass" which had hitherto been used for the glass "à la façon de Venise" was applied in the seventeenth century to the best kind of lime-glass.

Kreibich relates that in 1688 there were six glass-houses in London which apparently produced more beautiful glass than that imported from Bohemia, although the latter was cut and painted.

The magic clarity of the material made the English glass famous in the eighteenth century. Polishing and cutting were taken over from the continent via the Dutch, but they never reached that height known at the same period in Bohemia, nor did the shapes display that same elegance and variety; but they were purposeful and solid. Towards the end of this century the entire surface of the glass was covered with faceted diamond cuts. This manner of ornamentation was soon taken over by the Bohemian and Silesian glass-houses which developed it masterfully.

In English production, the eighteenth century milky glass holds a special place, since it was considered a replacement for the costly porcelain and was decorated with oil and enamel colours. Such glass was introduced to England from Bohemian glass-houses.

At the time when Kaspar Lehmann, at the court of Rudolf II in Prague, was carrying out his first epoch-making engravings on Bohemian crystal-glass and therewith laying the foundation for Bohemia's world fame — the New World was making its first uncertain attempts at glass production. In 1607 the first glass furnace was lit in Jamestown in the state of Virginia, but soon the fire below it went out again. Fourteen years later, the first Venetian was sent from London to America to establish a manufacture of glass beads, for which there was much demand among the natives. Glass jewels, however, have been found in Indian tombs in such quantities that some scholars do not exclude the possibility of their having either been imported from Europe or having been made at a pre-European period. Dr. E. A. Barber reached this conclusion since coloured beads were also found in Florida.

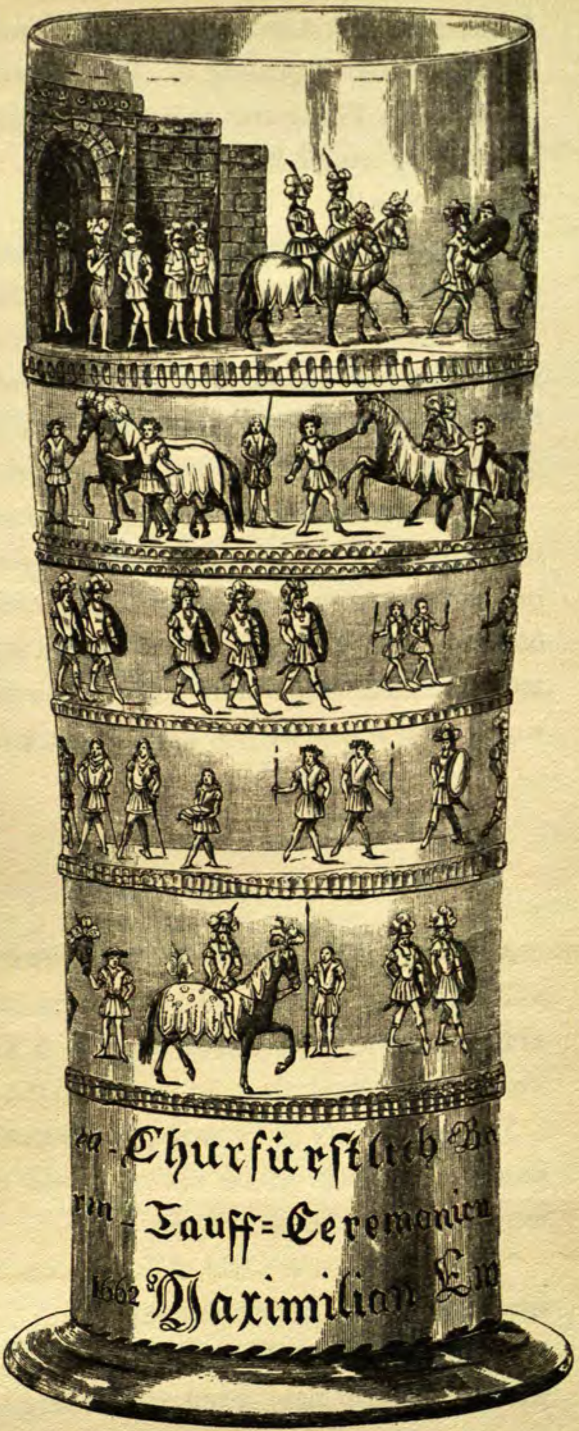
The first glass-workers in North America were Dutchmen and Poles, later Italians and for some two hundred years most of the glass-makers were of German nationality from the various provinces of the old Roman Empire, with Austrian, Bohemian and Silesian names.

Two Dutchmen ran an enterprise in New Amsterdam — today's New York — which failed around 1650. The real history of American glass production began with the names Kaspar Wistar and W. H. Stiegel, both from Germany. They set up business on a larger scale with the clear intention of freeing the increasingly wealthy country from the apron-strings of Great Britain. This tendency emerges clearly from news cuttings of the time.

"And it is to be hoped that the honourable inhabitants of these provinces will prefer buying those goods which have been produced by their fellow-countrymen, by which deed they would see their money returning to them which would be a vain expectation if their money went overseas."

After the Revolution, i. e., at the end of the eighteenth century, another German, J. F. Amelung from Bremen, founded a glass-house in Maryland and obviously he called workers from his homeland. He reports about this:

"The workers whom I engaged with great expense from Bohemia, Thuringia and other districts of Germany could not depart quickly enough because there was great frost. Many of them half starved on the journey, and those who succeeded in reaching us, could not immediately be sent on the way since the rivers were frozen up. Thus their intention became more publically known than was essential, whereupon some English merchants and sea captains from Bremen wrote about this to England. This jealous nation which considers the glass trade a reliable source of income, approached the government of Hanover to prevent the further journey of the workers by all means. The same demand was presented by the British government also to the governments of Brunswick and Hessen, so that I had to make a wide detour with my folk. Although in my pocket I had recommendations from great men, like Franklin, Adams and the American Consul in Paris, I had, as it were, to escape from Europe. After a difficult voyage of sixteen weeks we thirty-four finally reached Baltimore on August 31st, 1783. My representative who arrived here on November 22nd, brought further seven people with whom he had succeeded in embarking at



84. Cylindrical Bavarian drinking vessel from the year 1662, with a solemn procession, painted in enamel colours, held in honour of the christening of the son of the Elector. Reproduced from F. Slade.

Amsterdam after a secret trip across Friesland and Holland." How little window glass there was in America at the beginning of the eighteenth century is clear from a letter by an English nobleman of the time. The estate owners in Virginia, having amassed wealth, were beginning to replace their log huts by manor houses just then: "... instead of glass they had grease paper or even movable wooden slabs."

Transport complications caused the number of glass-houses to grow more rapidly in America than in Europe. There the distances were much larger and the conditions of the roads not suitable for such fragile cargo. Since glass was originally made from beach sands and since most marketing places were along the coast, glass-houses were founded chiefly along the sea coast and along the lower reaches of the rivers. Only in the second half of the eighteenth century did the track westward begin, and after the first mountain ridges had been scaled, the glass-amkers followed in the footsteps of the pioneers.

In America the custom developed of throwing away empty bottles, especially medicine bottles. That is the reason for the rapidly increasing output and it is not surprising, therefore, that both the hand production and the machine production of bottles arose in America. Certain types of bottles, e. g. the octagonal and the egg-shaped chemist's bottle were first made there. As far as lighting arrangements are concerned, lamps were given preference to candlesticks because wax and candles were in short supply, but animal oil was in plenty; e. g. blubber was used and prior to the rest of the world: petrol.

Germany

According to the earliest report, originating from the year 678, the bishop of Mainz sent glass-blowers to England. In Cologne, this old Mecca of glass, the first record of glass-makers comes from the year 1160; this, of course, proves nothing. A Viennese edict of the year 1334 speaks clearly of the sale of Venetian and local glass. In the year 1363 a glass-house was founded in Augsburg.

The real history of German glass begins, however, only with the expanding glass production of the sixteenth century, whose centre is said to have been Nuremberg. It is interesting that Gerspach formulated this fact as follows:

"... its centres are said to have been Nuremberg and Prague" (The latter probably as residence city of the Holy Roman Emperor.)

In the oldest West European and German literature the Bohemian glass figures always side by side with the German glass, together with the glass from Nuremberg, Saxony and Brandenburg. Professional German writers have treated the Bohemian glass as part of the German production without the least embarrassment. Of course, it cannot be denied that the Bohemian glass production reached its world fame at a time when Bohemia and Silesia were suffering under the tyranny of the German domination; their technology and refinement had a number of common traits; their economic bases were almost identical; but their origins are to be sought in utterly different places: the Celtic glass was not of Latin and certainly never of German origin; and it is important to bear this clearly in mind.

III

THE SECRET OF VENETIAN GLASS-MAKING

85. Venetian drinking vessel, painted with enamel and magnificently gilded, decorated with enamel beads. Reproduced from F. Slade.

MARGHERITA—THE GLASS BEAD

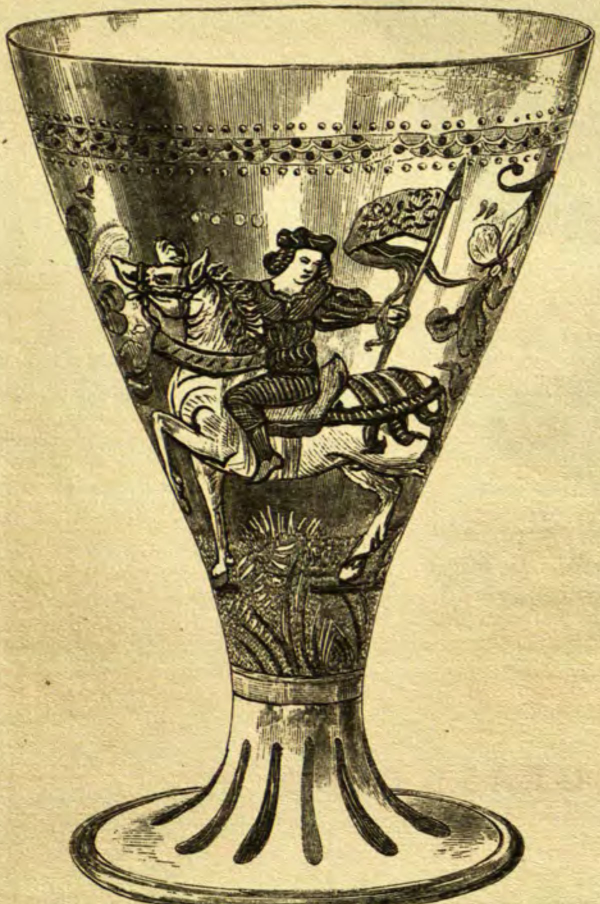
THE EAST ROMAN, Byzantine glass-houses, together with those in the Mohammedan countries in the Near East, were the sole makers of artistic glass almost until the end of the fifteenth century. But in the meantime, in the West a merchant republic was rapidly developing, which seemed the very image of old Carthage. In the eleventh and twelfth century Venice, undoubtedly, held the first place among the old merchant centres of the civilized world of the time. And since at that time the Orient was far in advance of the Occident in all branches of work, science and art, the Venetians directed their sea traffic mainly towards the East in order to catch up on this uneven development. Soon they realized that their economy, swollen through the exchange of foreign goods, could not keep its balance for long if they did not supplement their over-developed transport and trade by their own production in, if possible, a lucrative branch of industry. And so the shrewd North Italians founded their own industries and manufactures in their town, or in districts under their control.

According to the annals of the Murano glass-houses, the Venice glass-houses had existed since the foundation of the lagoon city. The participation of Venice in the conquest of Constantinople in the year 1204 gave the representatives of the Republic an excuse to examine the glass-houses and refineries there.

They were successful in persuading some former Byzantine Greeks to migrate to Italy. Hereafter we can follow continuous negotiations of the glass industry in carefully preserved documents in the Venice State Archives.

In the city itself production was forbidden because of the danger of fires. The glass-houses consequently, were moved to the island of Murano which soon was crowded with workers. Only the lucrative bead production remained in the city.

The knowledge of the oriental production secrets brought the Venetians immeasurable wealth, not only from the West but also from the countries of the East where the Venetian beads were in great demand among the populations of India, Middle and Central Asia and even China. The great travellers



86. Venetian drinking vessel, painted with enamel colours. 15th cent. Reproduced from Felix Slade.

of the time, such as Nicola and the legendary Marco Polo had a considerable share in their distribution. The documents name Christoph Briani and Domenico Miotto as inventors of the "Margherita" beads (from the Hebrew Margolith) whose production conquered the important market centre of Basra. The unheard-of business success of this product completely pushed the production of glass vessels into the background so that it may be rightly assumed that the glass vessels which the Venetians brought to Flanders and Burgundy at the end of fifteenth century had previously been bought by them in Byzantium.

The Byzantine Glass-Makers Migrate to Murano

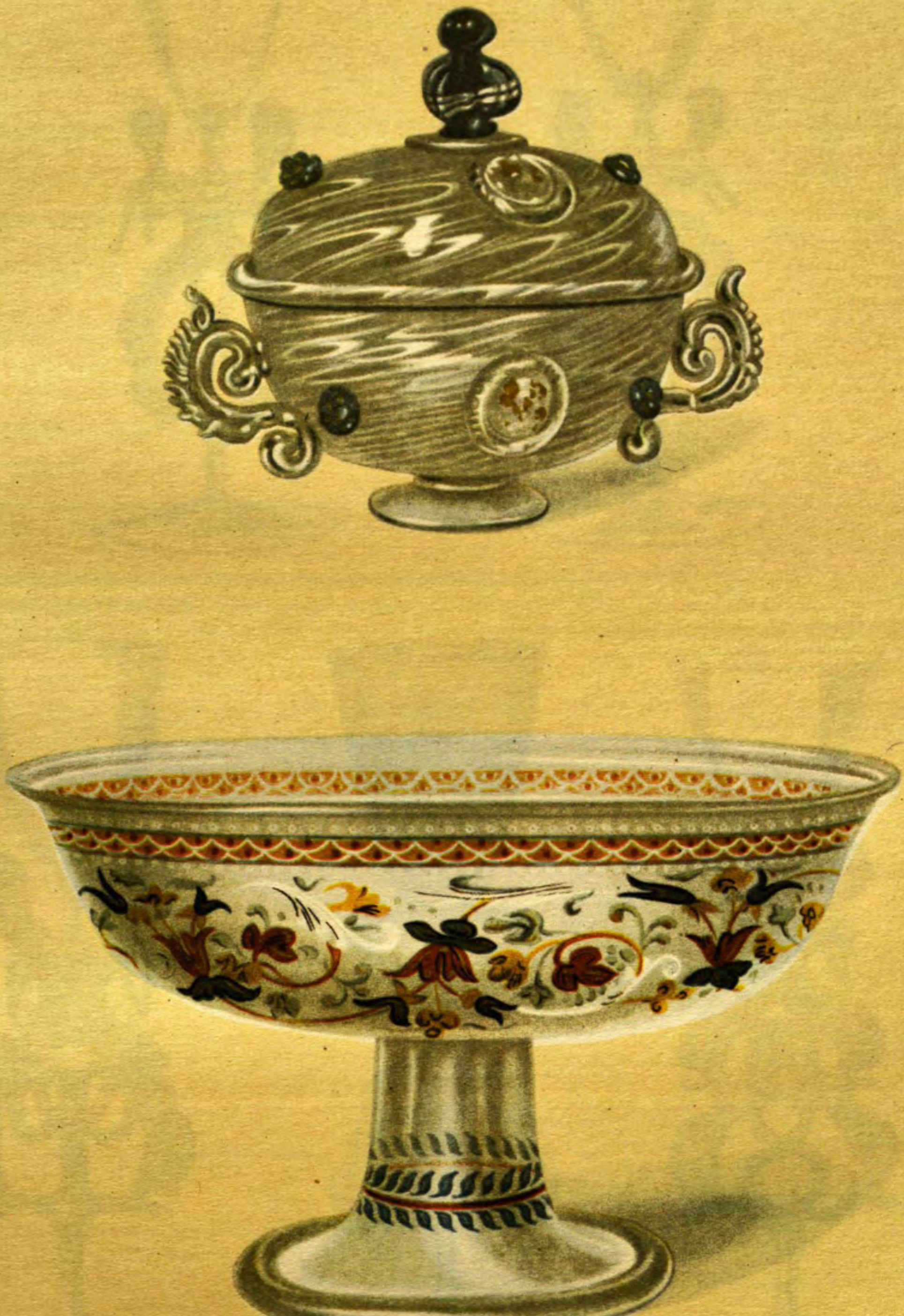
Just at this time the Turks made their decisive attack on Constantinople. The Greek glass-makers fled — to Venice where they were welcomed with open arms. This large-scale migration of all the specialists of a monopoly industry right across the Mediterranean Sea bears proof of the smooth organizing abilities of the Venetians. In this no one in the feudal world of the so-called "Christian West" could compete with them. In spite of their quite considerable economic means the others always came too late.

And so in the middle of the sixteenth century these men in a new environment discovered a new form of glass ornamentation, namely white filigree on otherwise transparent glass. This made it possible to maintain the unique fragileness of the Venetian glass, whose fame and popularity was again on the increase in the world.

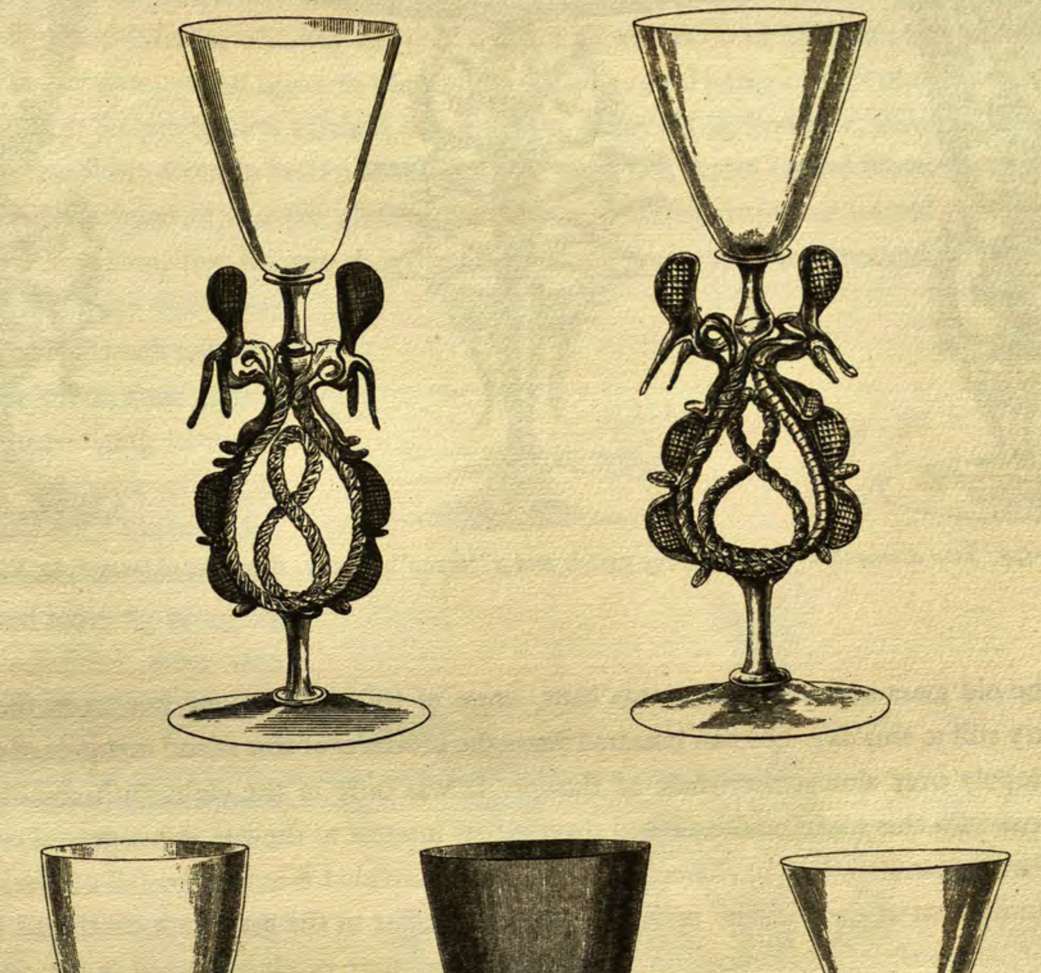
It is consequently not surprising that the government of the Venetian Republic protected their secret of the new production methods of glass. One of the ten members of the City Council was personally responsible for seeing that none of the glass-makers was tempted to go abroad. When finally towards the end of the seventeenth century Emperor Leopold I attracted some glass-makers to Austria, the Senate punished those who did not return by imprisoning their nearest relatives.

In contrast to this terror, the Republic granted loyal glass-makers considerable privileges. Already in the thirteenth century glass-makers held a rank equal to the patricians and their relatives were admitted to the highest offices. They had a special Chancellor, their own judges, and a representative in the Senate. In the year 1502, they were granted a special statute which even survived the collapse of this famous, purposeful, yet cruel Republic which had evolved capitalist forms of feudalism.

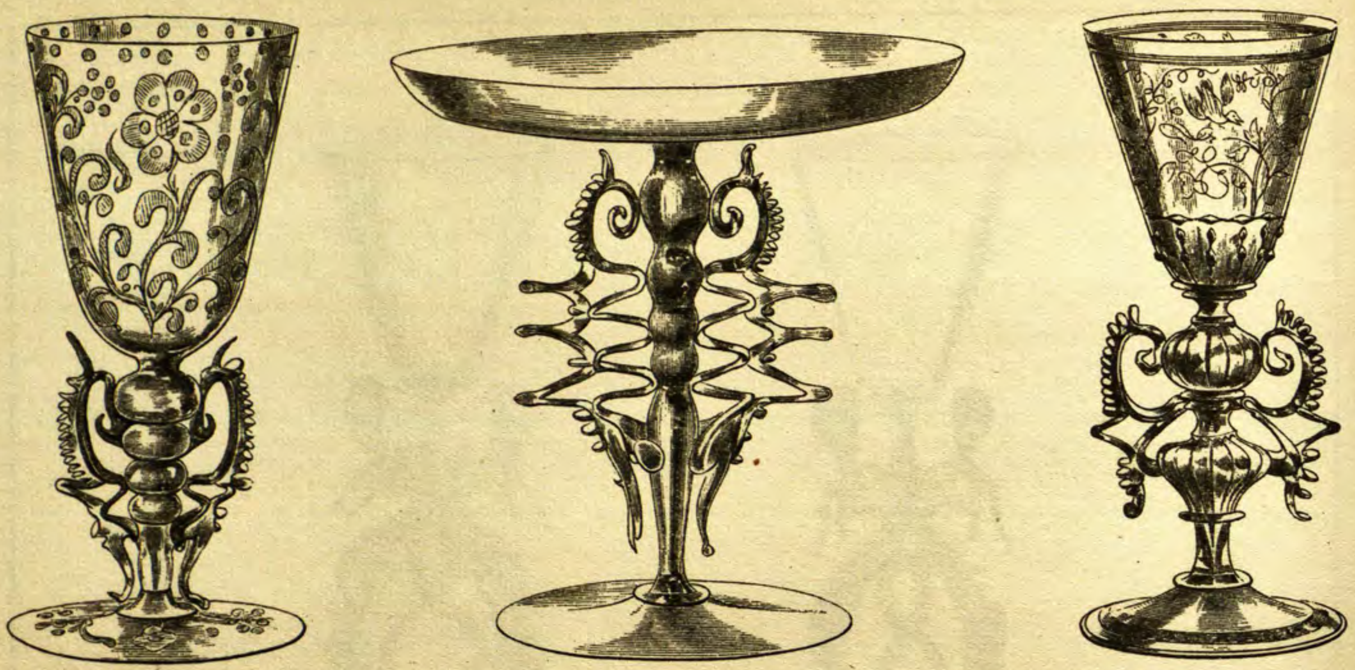
This glass-makers' statute forbade the usually all-pervading municipal police to enter the island of Murano. By a decree of the year 1383 the glass-makers were exempted from the guild rules and were treated exclusively as artists. When the French King Henry III visited Venice in 1573 he granted all the leading Murano glass-artists a rank of the French nobility. Beginning with the year 1602 a "Golden



COLOUR PLATE XXVII



87.—91. Five Venetian drinking vessels, with decorations in different coloured glass, milk glass and filigree. Reproduced from Felix Slade.



92.—94. *Two diamond stippled drinking vessels and a "tazza". Venice. Reproduced from Felix Slade.*

Book" of the old glass-makers' families was kept, some of whose names are known in the Venetian glass industry still to this day. For two hundred years the products of this island maintained an unchallenged monopoly over almost the whole of Europe. It was only in the eighteenth century that the fashion parted with this traditional style and diverted its interest to the cut and engraved crystal-glass which was being manufactured in Bohemia and the still undivided Silesia. The fall of Venice and the enforced cancellation of the Murano privileges led to a decline in the art which continued but a poor existence for long years. Only lamps and household dishes were produced, until, a few decades ago, a new wave of enthusiasm revived the old Venetian glass production; but, of course, not on a level and significance as before.

Nevertheless, we gaze with admiration at those incomparable vases from the period of its greatest fame, which we find today in palaces and museums in Italy and in many other countries, whose fragileness and beauty of shape have never been equalled by anyone at any place.

Thus ended an art which arose in direct succession to the Latin and Hellenistic experiments and which, having incorporated all the skill of Byzantine glass-making, developed it even further and lived through the creative breath of the Renaissance.

The Classification of Venetian Glass Production

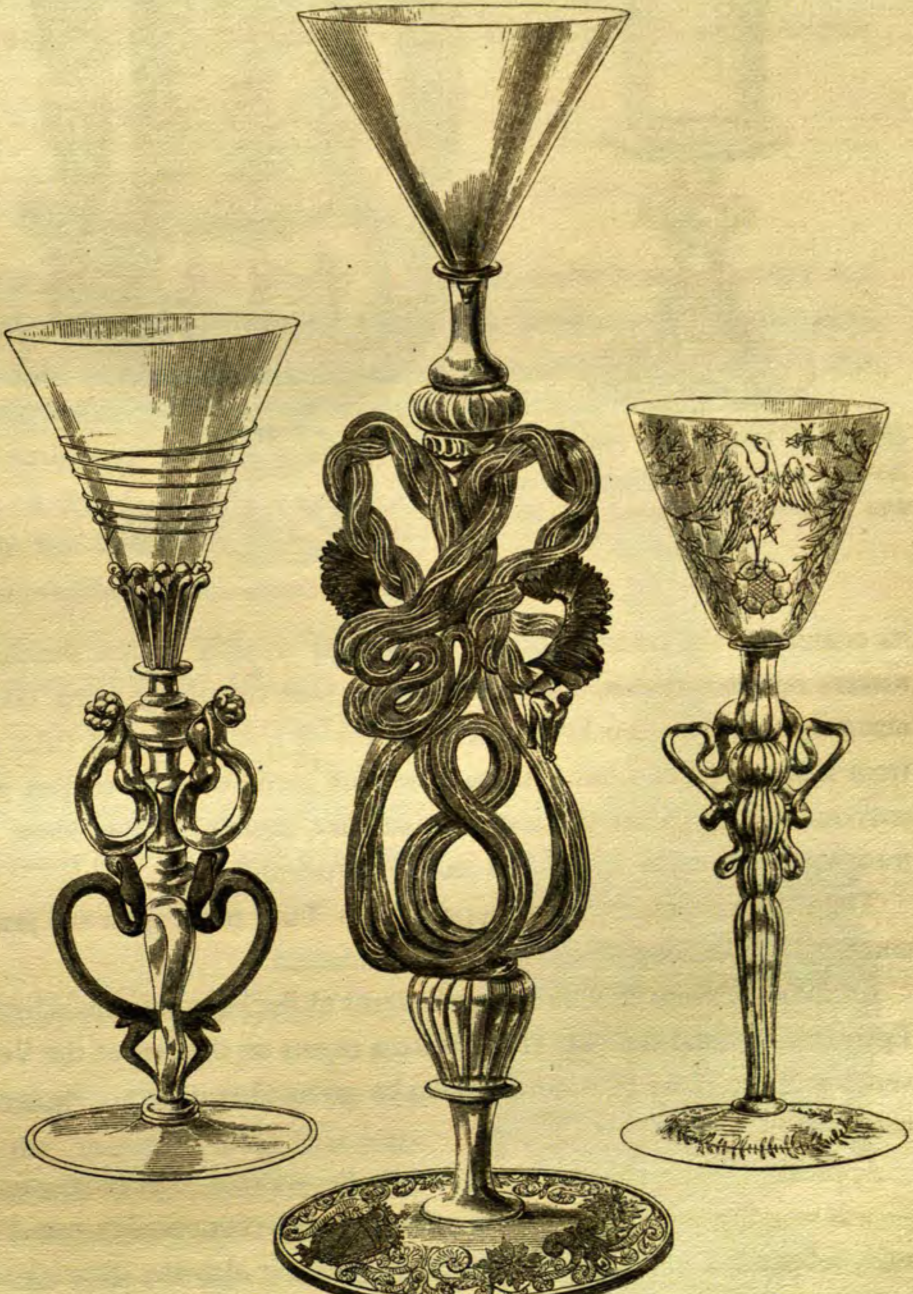
For us today it is extremely instructive to visualize the classification of the famous Venetian production according to its output. First came vessels of clear, white glass. They were followed by glass that had been coloured already in the mass and third place was held by the enamel-ornamented and gilded pieces. Then came vessels covered with coloured glass fibres and hollow glass, decorated with filigree; there were two processes: twisted (ritorto) and netted (reticello). The fifth and last branch was formed by the mosaic vases.

§ 1. Under white glass we understand clear, colourless glass-ware in contrast to the frosted, opaque glass. It was known in Venice sooner than the coloured varieties and all the oldest products are made of it. By decorating this white glass with coloured threads that were spun around its outside, Venice developed a production process analogous to the Byzantine method. First they used only blue, sometimes blue, gilded threads, whereby the gold did not appear as outer addition, but was directly mixed into the mass of glass, so that not even the addition of lime could harm it. This glass gave the impression of being dusty. Its production method is not known today. It is, however, assumed, that the melter threw in a few foils of thinly beaten gold when the mass was liquid before blowing started. The gold disintegrated, scattered all over the glass bubble that was taking shape and caused those organic strips and dots which form the structural decorations of the material. This method of mixing the gold leaf into the glass mass was used until the fifteenth century. Among the white, clear glasses the most interesting example, perhaps, is a vase of apparently cracked, ice-like material. Such internal fissures can still be achieved today by plunging the half-solidified mass into water and immediately re-heating and blowing it.

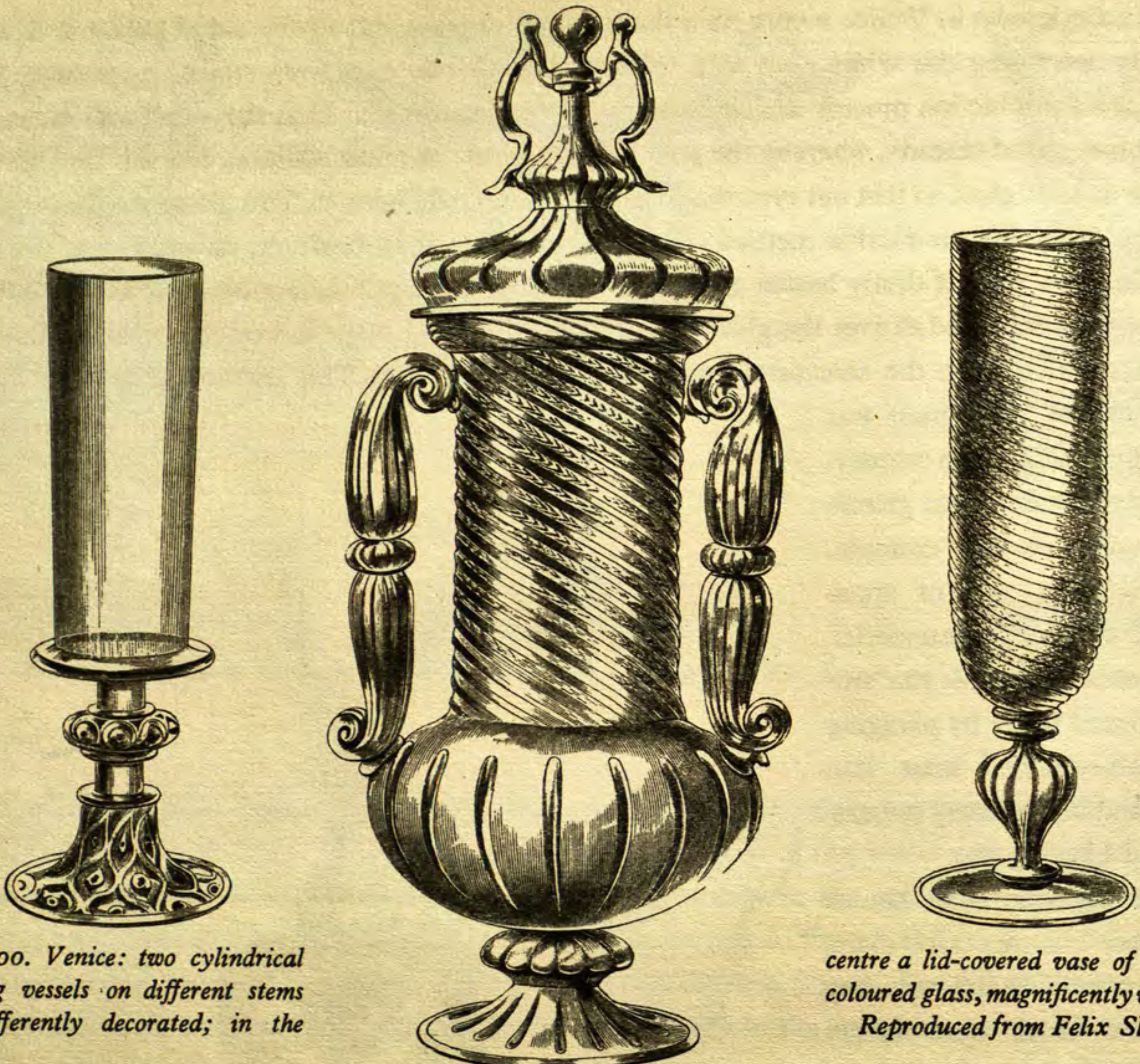
The Venetian glass-houses also made bizarre vessels in the shapes of animals and legendary creatures which were mainly destined for the romantic alchemists of the time. They probably also served for apothecaries and distillaries. The creatures often had wings attached to them and claws or necks of coloured, usually blue glass. The vases were ornamented with similar relief figures which were achieved by blowing them into negative casts; many of them had ornaments pressed into them and then gilded. This was done by means of special stamps which were pressed into the still glowing mass.

All this belongs to the technique of white, clear, transparent glass.

§ 2. The coloured glass gained



95. Venetian wine glass on high stem with a chalice decorated with spun glass. Slade. 96. Venetian wine glass on an eccentric, complicated stem. Slade. 97. Venetian wine glass on high stem engraved with a diamond. Slade.



98.—100. Venice: two cylindrical drinking vessels on different stems and differently decorated; in the centre a lid-covered vase of amber-coloured glass, magnificently worked. Reproduced from Felix Slade.

its colour by the addition of one or several metallic oxides during melting. The Venetian glass-makers revelled in this. They obtained a blue colour by using cobalt oxide, violet by means of manganese oxide, green by copper sulphates or iron oxide, red from gold ("ruby-glass") and yellow from silver. The two last colours were only used in later Venetian glass and, strangely enough, are only rarely seen. After the sixteenth century, moreover, they knew how to make a milky glass by means of zinc oxide which was called "latticinio".

They used arsenic to achieve opal effects. They made agate and jasper glass by means of different combinations, among which silver predominated.

All these different colours are reminiscent of the later inventions by the North Bohemian, Frederick Egermann, around the year 1800. Since a report on the arts of the Venetians can be found in the inventory of the Duke of Anjou, it must be assumed that they were in use already before the sixteenth century.

Approximately in the year 1450, Angelo Beroviero — a phenomenon among Venetian colour mixers — was working in Venice. He was a disciple of the famous alchemist Paolo Godi del Pergola who, it is said, revealed to him the greatest secrets of colour alchemy. Bearing in mind that Constantinople fell at that time and that the Greek glass-makers were shipped to Venice, we can imagine the real facts behind these official explanations. Angelo's fame was inherited by his son Marino.

The inventory of the collection of Charles the Bold (1467—1477) contained a number of coloured

Venetian glasses. There was also a standard left by Maximilian for the Austrian inhabitants in Bruges. Among the coloured glass of the time must also be counted "Avanturin glass" whose colours were attained by a repeated heating of the mixture. The production method was lost for a long time until it was re-discovered in 1847. In the seventeenth century the Venetians coloured "ruby glass" with Cassius purple. But in this they never attained the high technique of the Bohemian or German glass.

§ 3. And now some fleeting remarks about the enamelled vases and the gilding of glass. By this, we understand the ornamentation of the finished products of white or even coloured glass by a separate process with gold or other vitrifiable pigments which were put on with a brush and then fired. The ornamentation was done in the Byzantine way, which the monk Theophilus described. Although the Venetians followed the Greeks in this, they may have gained this secret already before the fall of Constantinople, since there are earlier samples in existence. Frequently the gilding was enlivened with white beads or blue stripes. Such vases were in great demand all over Europe and are scattered over many countries to this day.

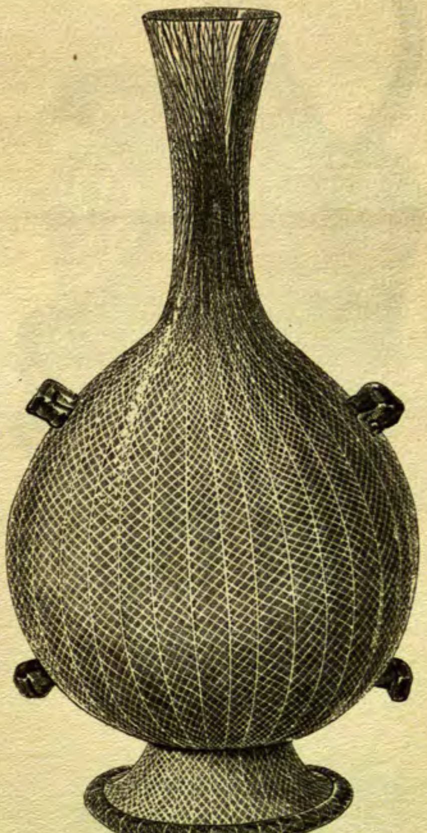
Hollow Glass with Coloured Threads and Filigree Decorations

These two techniques can be placed in the same category because the method of production and use was, in fact, identical. Their technology presents no secret today. It is used in modern manufacture even if it does not achieve such light weight and such inimitable splendour of form. For in this modern glass should make great endeavours to raise its level to that of olden days.

Vases of this type were made by adding a certain number of small rods in cylindrical form, 3—6 mm in diameter, either of white, opaque or coloured glass. In this way simple "spun-glass" vessels were made, or ornaments were added to vases which already contained filigree work. These rods were prepared in the order needed by the glass-maker who often alternated different types of glass. Having been melted together in the heat, they were blown into a homogenous mass, and then they were treated like every other blown hollow glass. A vessel of this kind consisted of twenty-five to forty rods. First we must discuss how these rods were prepared.

The Preparation of Rods for Spun-Glass

The worker "gathered" a small lump of viscous glass at the end of his blowpipe and rolled it on the "marver" (as the iron plate was called) until it adhered to the end of his implement in the form of a thin tube, six to eight centimetres long. This was left to cool a little. Then he dipped this glass rod into a colourless, clear glass to receive a coating of transparent glass and rolled it once again on the "marver" until a thicker rod formed. Now he pushed this rod of compact glass into the workhole, left it to reach

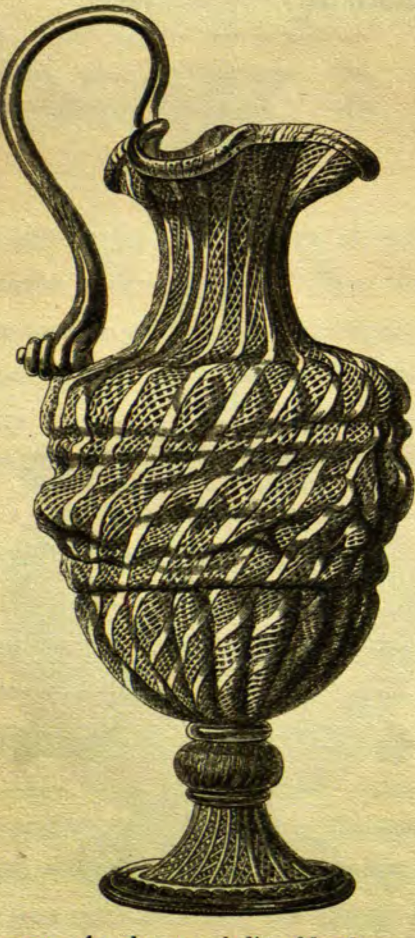


101. Venetian bottle with fired decorations in filigree technique. Reproduced from F. Slade.

a high temperature and then skilfully pulled it out until a three- to six centimetre thick thread remained which was coloured inside and enclosed in a fine, transparent isolation layer. Before application on vases and other vessels the thread was pressed flat so that it formed a barely protruding net.

The Filigree Thread

The production of rods for the filigree work was still more complicated and depended on the patterns desired for each piece of work. The rods were made in the sequence that corresponded to the design. The intervals between them were filled with colourless, transparent glass. All the rods were placed along the inside wall of a short earthenware cylinder. The centre was filled in with a solid cylinder of colourless glass. In this way a solid rod was created in which the colourless threads were situated at regular or irregular intervals either on the outer or the inner side of the colourless material. This whole cylinder was then re-melted in the fire and pulled out to a three to six centimetre thick rod so that the originally thick rod with the adhering fine threads formed now immensely thin rods which were then rotated or twisted according to the design and colour pattern. Sometimes a screw pattern was used. For further mention of the production of such rods we cite the classical instructions by Bontemps ("Exposée des moyens employés pour la fabrication des verres filigranés," 1845) which describes in detail the various admirable designs of the Venetian filigree vessels.



102. An almost unbelievable shape of a Venetian filigree jug. Reproduced from Felix Slade.

The Complicated Technology of Filigree Designs

To make the little rods for the threads which are to be twisted into a spiral and which, when squashed flat, form a network (illustration A) we prepare a small cylindrical clay basket which is seven to eight centimetres high and somewhat narrower. We line this with alternate coloured and colourless rods. All of them are attached to the bottom of this cylinder with a little clay, never more than five to six centimetres up. Illustration A-1 shows how they should be attached. A-2 is the same in cross-section. This clay mould is lined with the rods and is then re-heated to a point at which the threads inside almost collapse and become "ripe" and fuse completely with the colourless mass of glass which is then taken out of the "hole" (i. e. the workhole of the furnace) and rolled on the "marver" until a massive bulb is formed which can easily be fitted into the hole left by the arrangement of the rods. The entire glass bulb is once again raised to a high temperature, is placed inside the earthenware cylinder and pressed into it so that the rods adhere to it without, however, changing their original positions by a hairbreadth.

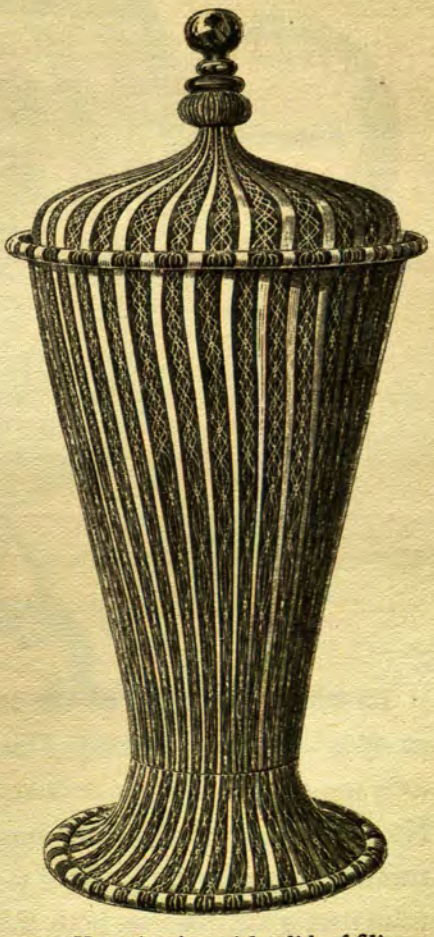
While the assistant holds the mould, the master takes out the contents and it can be clearly seen that the rods adhere now to the transparent glass bulb. This bulb is now once again raised to incandescence to strengthen the adherence of the rods; then the worker, by melting only the ends of the rods, cuts them with his pincers so that the threads form a point into which all merge. This point is once again melted, held with the pliers in the right hand and the left hand rolls the cylinder and twists it to a spiral. When now finally the glass-maker gives the threads the desired width (3—6 cm) by a rotatory movement and when he is of the opinion that the threads are satisfactorily and evenly twisted, he cuts off the end.

Once again now he melts the end of the glass lump, twines a second and third thread from it, and so he continues until the entire content of the original clay mould is consumed. These are those rods with the spiral patterns which later, by blowing of the filigree mass, are flattened and which give the clear glass the appearance of colour threads, visible on illustration A.

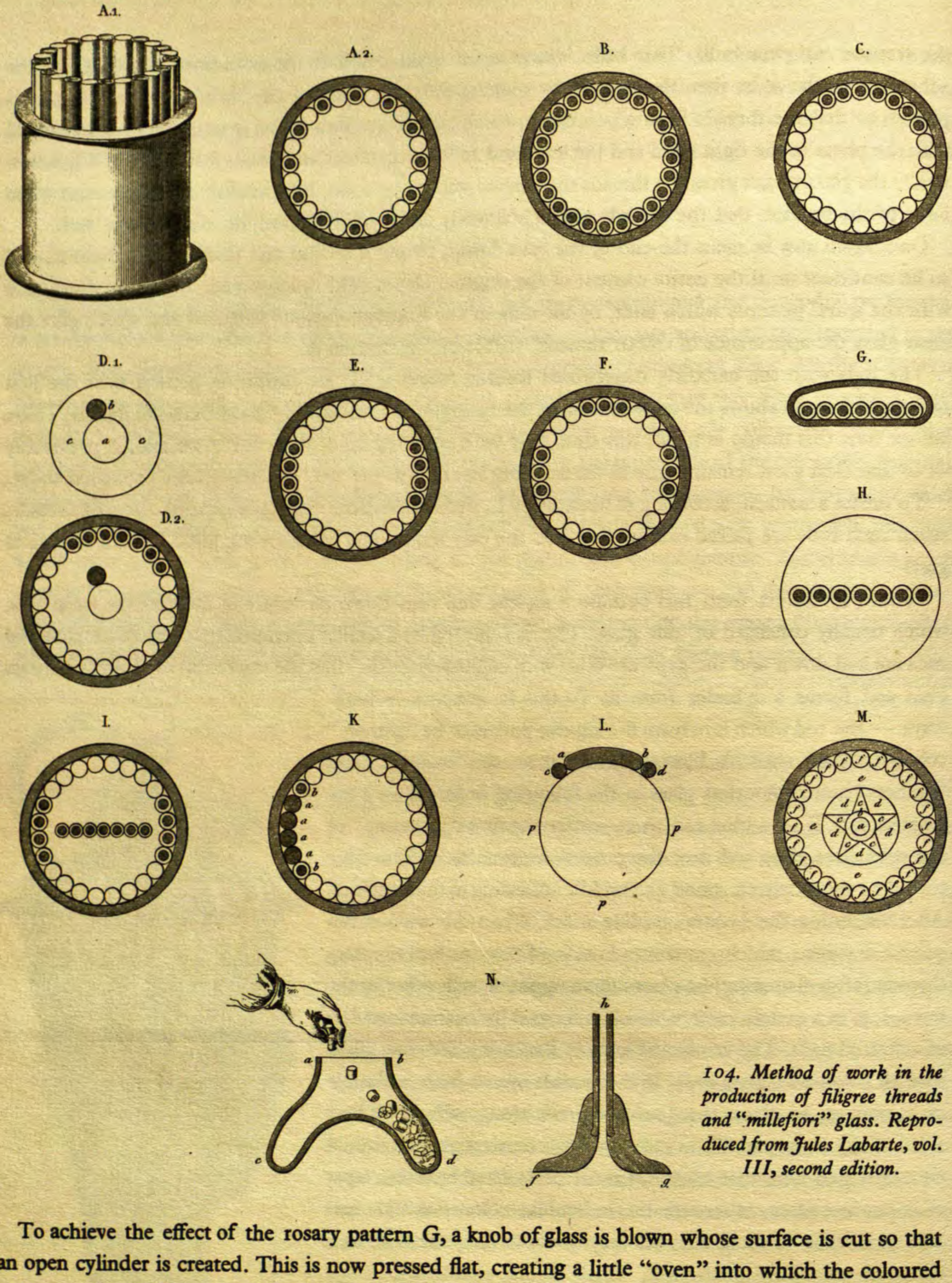
The rods with the narrowly intertwined threads (drawing B) are shown on pattern B of the first table, which again shows the cross-section of the fusing of the threads in the earthenware mould. There we see how this mould is filled; this time only with coloured threads — not colourless, as previously — so that clear glass remains only in the isolating layer. This process has already been explained above.

To create a pattern, according to illustration C, with seven spiral and screw-shaped coloured threads, seven such rods are placed side by side into the clay mould and the gaps are filled in with colourless glass.

Pattern D differs from this because a zig-zag line runs down its centre, a little off the main axis, which usually consisted of blue glass. This is achieved by a similar operation by which seven coloured rods are laid down and the gaps are filled with colourless glass. Then the worker takes a little colourless glass and forms a cylinder from it. To this he attaches — longways — the rod which is to form the zig-zag line; now he "gathers" colourless glass with his blowpipe, rolls it on the "marver" and "gathers" more colourless glass in the following order: A — a colourless rod, B — a blue rod, AA — after the first "gathering" of the colourless glass and now the process repeats itself. The blue thread is then twisted round the middle according to the diameter. After flattening the mysterious line arises. When the worker has gained a thread which contains a bundle of three or four crossing threads (after flattening) he places them opposite each other in the form, i. e. in a certain pattern which is formed by a certain number of coloured rods. The remaining gaps in the lining are now filled in with colourless glass rods. If the threads are to form a double cross pattern, he places three coloured rods along each of the four sides of the form and fills in the rest with colourless glass. It should be mentioned here that each rod must be isolated by a thin layer of colourless glass, otherwise the individual colours would fuse into each other. Without this trick they would have to alternate each coloured with a colourless rod, which would greatly widen the transparent gaps and would not create such a clear-cut pattern. The distance between two coloured rods with this transparent layer is considered sufficient when the cross-sections of the original rod is surrounded by an isolation layer which corresponds to half its thickness.

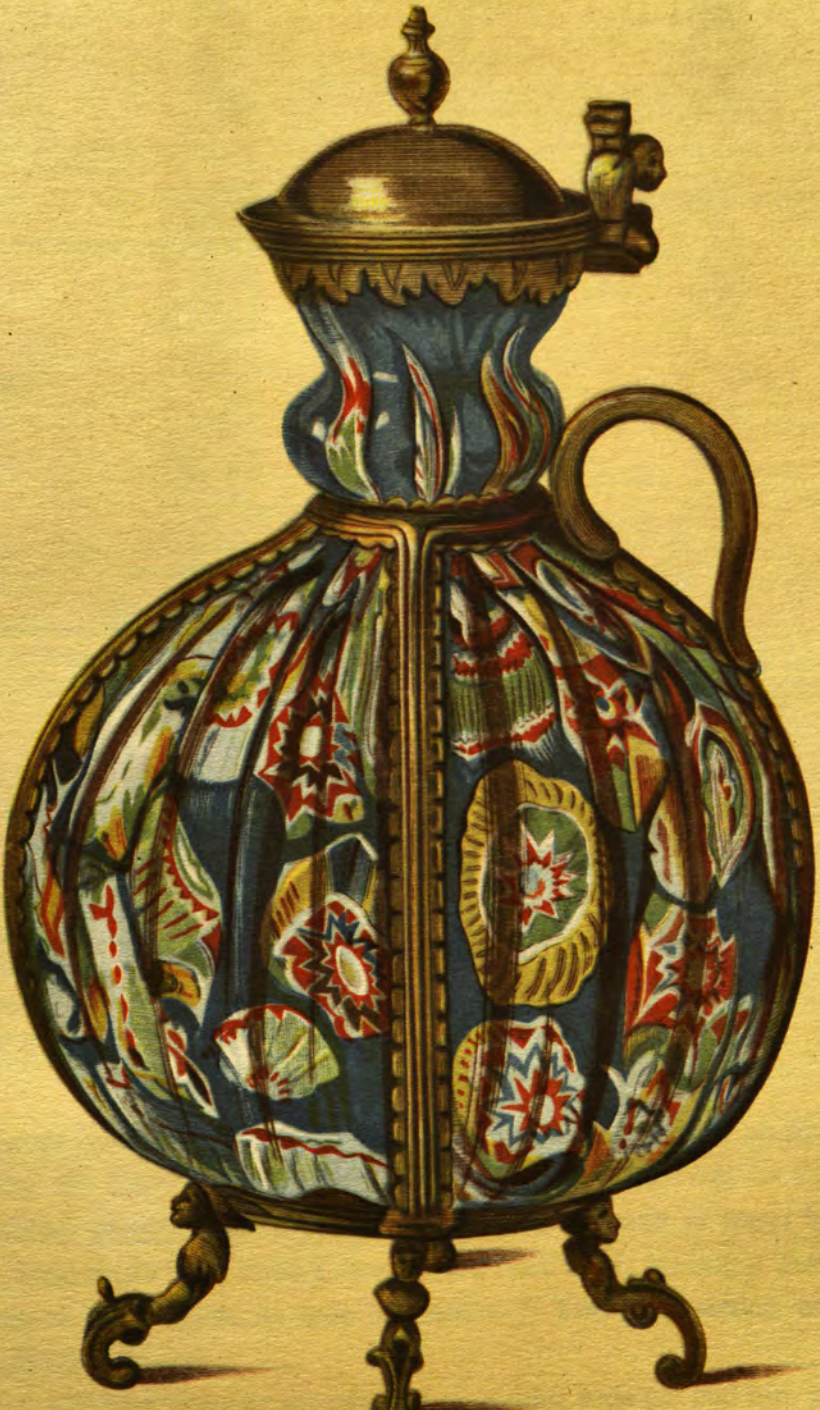


103. Venetian jar with a lid, of filigree glass. Reproduced from F. Slade.

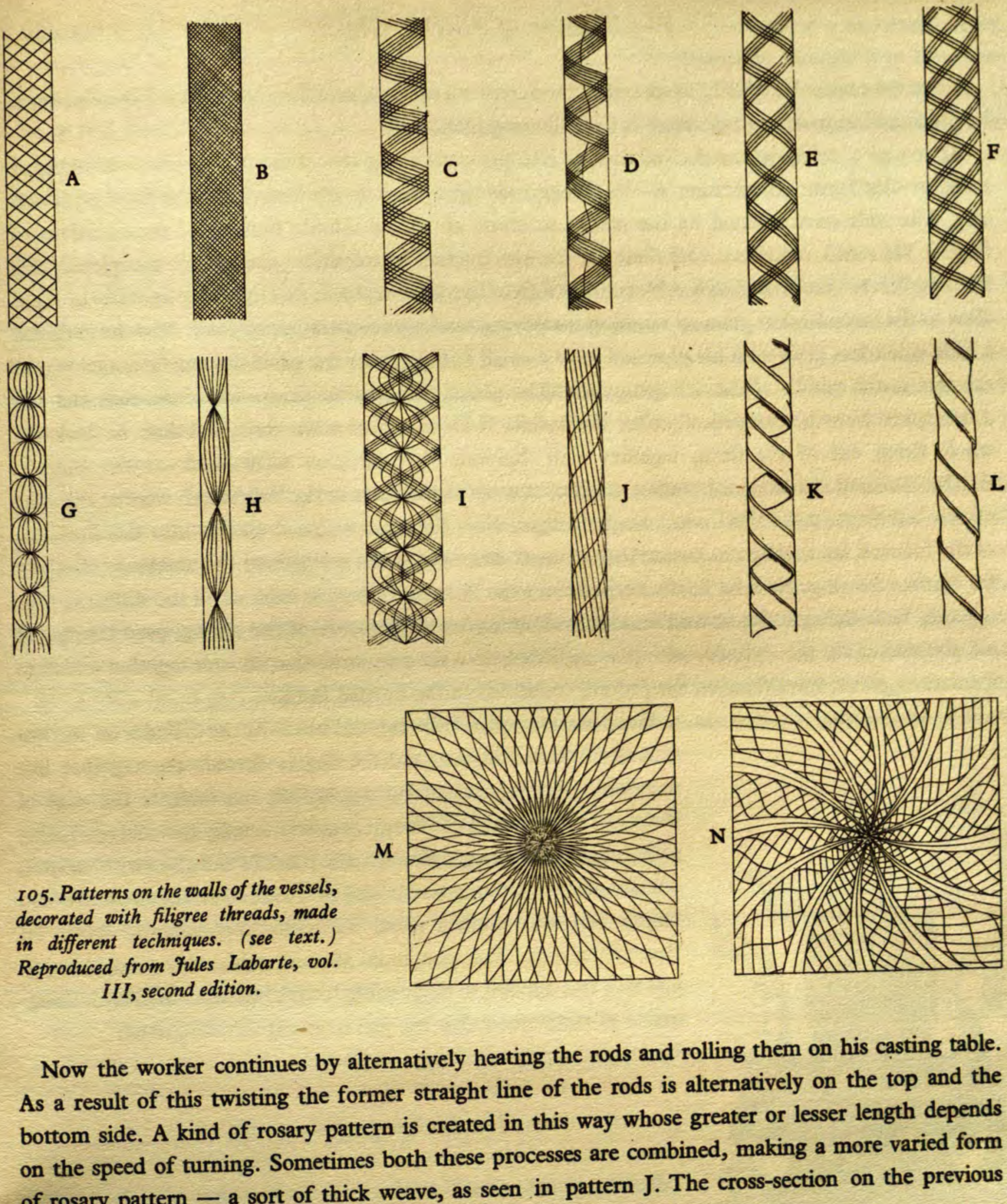


104. Method of work in the production of filigree threads and "millefiori" glass. Reproduced from Jules Labarte, vol. III, second edition.

To achieve the effect of the rosary pattern G, a knob of glass is blown whose surface is cut so that an open cylinder is created. This is now pressed flat, creating a little "oven" into which the coloured rods are placed. This is re-heated to enable further flattening until the two walls touch each other. Now the worker presses the outer walls with an iron implement while the assistant sucks out the air from the former cylinder until the form is baked together. The master then places a little incandescent colourless glass mass on both sides of the former "oven" and rolls it on the "marver" to create once again a cylinder. In this way the glass cylinder is made whose cross-section is given in pattern H.



COLOUR PLATE XXVIII



105. Patterns on the walls of the vessels, decorated with filigree threads, made in different techniques. (see text.) Reproduced from Jules Labarte, vol. III, second edition.

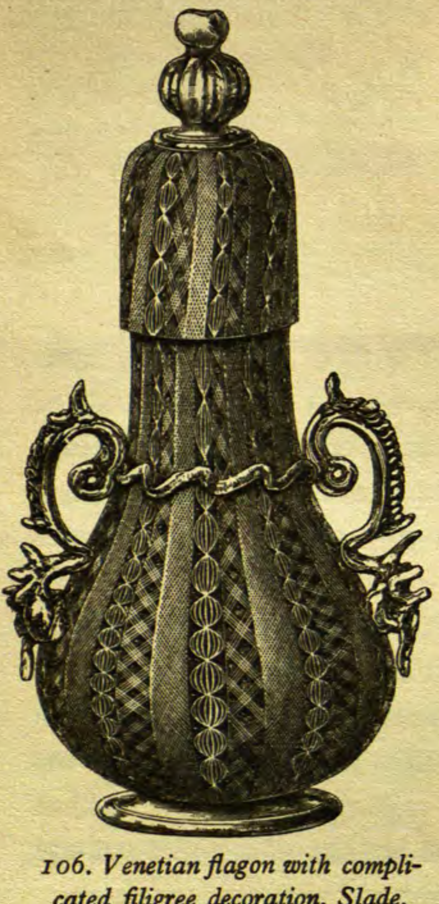
Now the worker continues by alternatively heating the rods and rolling them on his casting table. As a result of this twisting the former straight line of the rods is alternatively on the top and the bottom side. A kind of rosary pattern is created in this way whose greater or lesser length depends on the speed of turning. Sometimes both these processes are combined, making a more varied form of rosary pattern — a sort of thick weave, as seen in pattern J. The cross-section on the previous illustration presents the identical pattern.

For the creation of rod K a certain number of coloured, e. g. blue rods are laid into an earthenware mould, which, this time, are not covered in colourless glass. On both ends of the row two rods of contrasting colour, e. g. opaque, milky colour, are placed, and the interior of the form is lined with colourless rods. The blue rods form a continuous blue belt with a thin, milky-white hem. If the belt and hem are to stand out, (pattern L) then along the cylinder of colourless glass a thin plate of blue glass is placed which has milky-white threads on both sides. After heating, all is pulled out and twisted and a rod is created which has a relief line of blue lined by white.

When the master had finally "gathered" the colourless, coloured and the rods with a filigree pattern, he continued to make a glass vessel in the following manner:

He placed a sufficient number of rods to line the walls along the inside of a cylindrically-shaped metal or clay form. (Illustration A—1.) These rods were stuck to the bottom of the form with soft clay. The rods were selected by the master to create an almost infinite number of combinations of filigree. He could, moreover, vary them by the introduction of colourless glass. Once completed, this form was left to heat in the furnace. Not only to soften the rods, but also so that they may be safely brought close to the incandescent glass on reaching the normal working temperature of glass. Now he gathered a little colourless glass with his pipe and blew a small bubble. After the usual shaping (arrangement of the core in the middle of the still syrupy mass) he placed this into the centre where the rods had left a free space. Now he energetically blew the bubble for it to adhere to the rods, and then he took the whole thing out of the form, together with the rods that by now were stuck to the bubble. At that moment the assistant worker attached a strip of soft glass to the rods which were at the edge of this bubble to make their attachment stronger. Now the master placed all this into the workhole of the furnace, let it soften to ensure that all parts were well fused and gained the necessary elasticity for further blowing. Now he finally shaped it on the "marver". And as soon as all the different rods together with the cylinder formed an even bubble under the pressure of the strong, even current of air, the master cut this cylinder with pliers a little below the bottom so that all rods together ended in a common point; from then on the process continued in the normal fashion.

If the master, when blowing, did not twist the cylinder on its own axis, the coloured threads and the filigree threads ran together like meridians from top to bottom, respectively ran towards the edge of the vessel. But if he twisted the piece as was usually the custom during glass blowing, holding, however, the point of the glass with an iron, a screw-shaped pattern was created in which all coloured threads and filigree ribs were given a spiral line. This is frequently found on Venetian glasses. The people in Murano called this kind "ritorcimento"; this applied to all possible forms, but was, in fact, a designation of the process that has just been explained in detail.



106. Venetian flagon with complicated filigree decoration. Slade.

The Netting of Spun Glass

It is known that the Venetian glass-makers were able to produce vessels from threads which lay in two different directions. These threads were of one shade of colour, twisted and later placed in a crosswise fashion. Thereby a net of non-transparent threads was created where nothing remained inside the meshes of the network but little air bubbles. These pieces were called "reticelli" ("reticulated") glass and they brought the Murano masters their greatest fame.

In the middle of the nineteenth century some Italians tried to copy this art in the following way: On table 2, illustration M, we see the bottom of a decorated vessel, ornamented in this fashion. Before the revival of this long-lost art Bontemps thought it to have been done in the following way: The first cylinder was blown with a thread of simple twist and the second with one that lay across it whereby one knob had to be open in order that the second could be placed within it. Practice has later confirmed his assumption. But do not ask about the skill needed for this task — go to a museum and have a look at these marvels.

Millefiori — the Revived Egyptian Wonder, the Mosaic Flower Glass of Italian Provenance

The Venetians made vessels from rods whose walls were ornamented with stars, flowers, garlands and other regular figures in the most varying colours. First, let us describe the production method of a mosaic rod, according to illustration M on table I.

The worker "gathered" a lump of glass from the crucible, formed a small solid cylindrical knob, dipped it first into clear white, then into a different coloured glass; he rolled this enlarged, two-coloured knob and attached to its side five blue rods which he shaped with tongs in such a way that they formed with the core a three-sided prism, wings as it were. Now he filled the interstices of these wings with, e. g., yellow glass. He rolled all and dipped it into violet glass. The composed cylinder of glass, prepared in this complicated fashion, was then lowered into a form whose inner walls had already been lined with, let us say, milky-white rods whose cross-section formed a kind of natural ring resembling white beads. When the master heated all this together and took it out without twisting, he obtained a rod whose cross-section formed exactly the pattern M. He could, of course, fill the inner wall of the form with complicated patterns of different rods and, moreover, place these inside a variegated cylinder until he finally had a lump of glass of exceedingly complicated cross-section. In this way an immense number of patterns could be created, penetrating the entire material for the vessel. And now let us consider the Murano production which used such complicated rods of "millefiori" glass which the old Romans called "vasa murrina".

The rods were cut into ten to fifteen millimetre thick disks; these disks, that had, of course, previously been heated, were then attached to a colourless or coloured bulb so that on the "marver" the knob was enveloped by them. Then the whole mass was reheated and blown in the normal way to its final shape. Similar glass vessels were attained when the points of the bulbs were pressed inside, like the bottom of a flask. (Table I, illustration M). After annealing, the entire space that had remained empty was filled with small pieces of rods. Now this knob was gradually re-heated. In the meantime, a disk had been prepared on a different blowpipe, not, however, large enough to obstruct the opening of the other blowpipe. This disk was then inserted at the opening of the first knob, re-heated and blown whereupon the glass bubble

107. Small Venetian jug with complicated filigree decoration. Slade.

was "cracked off" the pipe. The other side was treated in a similar way with the help of a third blowpipe so that a new knob was created which could be treated at will.

I wanted to convey a truthful picture of the work by giving this detailed description; here we are close to a craft which approaches artistic evolution. Those who were fortunate enough to be able to see with their own eyes the work of glass-blowers in Bohemian glass-houses can perhaps imagine the full significance of Murano which was later deprived of its leading world-position by Bohemian glass which held this rank for two to three centuries.

One thing may not be passed over here in silence. Such dexterity was and remains dependent on that soda glass which the Venetian glass-houses used; this was considerably easier to melt than the Bohemian product and it annealed more safely and gradually. Otherwise it is a question of taste which doubtlessly influenced the nobility of shapes. We know what Frederick Engels said about the Italian Cinquecento, which actually stood as godmother to these glasses:

"Italy rose to an undreamt-of flowering of art, which seemed like a reflection of classical antiquity and was never attained again . . . It was the greatest progressive revolution that mankind has so far experienced, a time which called for giants and produced giants — giants in power of thought, passion, and character, in universality and learning. The men who founded the modern rule of the bourgeoisie had anything but bourgeois limitations . . . The heroes of that time had not yet come under the servitude of the division of labour, the restricting effects of which, with its production of one-sidedness, we so often notice in their successors." (F. Engels: "Dialectics of Nature" pp.2, 3. English Edition 1940).

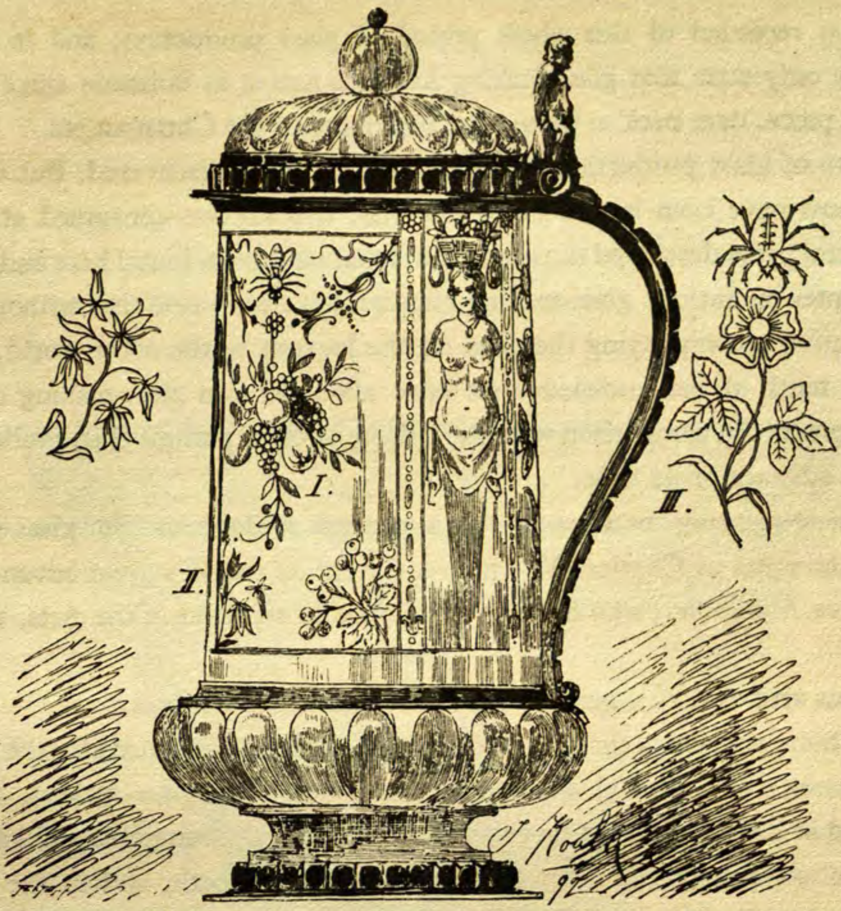
We hold our breath when we gaze at the glass cases of the Prague Art and Crafts Museum with their considerable collection of those Renaissance goblets, those feather-weight, spun-glass vases and flasks by the Murano artists; and one cannot help thinking:

Yes, those masterly works of the glass-makers which compare favourably with all the creations of Renaissance artists in other fields originated, indeed, at a truly happy period where man, freed from the spiritual dictatorship of the Church whose fetters he had broken, painted the Sixtine Chapel, had a faint presentiment of the physical discoveries of the future; he calculated, wrote poetry and was a masterly swordsman.

Only the revolution from capitalist enslavement to a free socialist world, in which the exploitation of man by man ceases, can offer the society of the future such and even greater pre-conditions for a gigantic development of thoughts and emotions; here man, freed from all that fetters and burdens him, in complete balance of all his mental and spiritual powers, can once again devote his energies to the most useful and beautiful thing: to work which is most completely conscious and truly joyful, whose sweet taste he had almost forgotten.

IV

THE VICTORY OF BOHEMIAN GLASS



108. Jug cut from rock-crystal by Kaspar Lehmann, set with gilded silver and decorated with magnificent Czech garnets, Lehmann's work was drawn by J. Koula, its discoverer in the Vienna Museum. See chapter on Lehmann and his work.

HOW BOHEMIAN GLASS-MAKING GAINED FAME

IT WAS A LONG WAY to the secret with which the Bohemian glass conquered the world, putting even Venice in the shade during the seventeenth century. It is that path that led us from the Celtic traces of the earliest Bohemian glass via the toilsome research in the chronicles of the monasteries. In those we might, at the most, read in 1300 that Abbot Bavor of the Brevnov Monastery bought beryllium glass for three pounds of silver, a crystal siphon for thirty pounds and a crystal monstrance for seven pounds; or we may read that Vojislav, the provost-vicar of the Prague Church bequeathed three silver siphons and glass to his relatives. Moreover, this glass made in Celtic Bohemia — Boiohemum — and the glasses produced in the fourteenth century bore such a close similarity to those pieces which were being made at the same time in Germany and in France, so that even experts have difficulties in determining their place of origin. Professor Dr. Zd. Nejedlý discusses this in his book, in the chapter on "Stradonice" — a village on the river Berounka, West of Prague. Here already in the nineteenth century a settlement of the Bojers was excavated.

"Many things were made from glass. Beads, transparent green as well as opaque blue, violet or brown-black glass. Inside, these beads had mostly a different colour, usually a yellow stripe or dot. In the old castle some blown-glass vessels were found, made of green, transparent glass; in the settlement there were even some little bottles of the so-called filigree type (multi-coloured glass rods melted together)."

Nothing has been recorded of this whole period of glass production; and as far as our work is concerned, we may only state that glass-making has been native to Bohemia since days immemorial, and that the oldest pieces date back to before the beginning of the Christian era.

The earliest date of glass production will probably never be discovered. But one can claim with certainty that it must have been in the Celtic era. And this art was continued at a later date when the heat of the funeral pyres destroyed those remnants that have been found here and in other countries. Already in the chapter on antique glass-making mention has been made that without the rich number of Roman funeral gifts, accompanying the dead on the journey to the other world, we should hardly have acquired one tenth of the knowledge we have about Roman glass-making and its remarkably progressive development. In comparison with the culture of other nations this, similar to the hellenistic culture, was far in advance of its time.

When treating glass-painting there was barely a mention of Bohemia. But glass-painting flourished in Bohemia from the reign of Charles IV, whose intervention led to a great advance. Reginhard, the Abbot of the Sázava Monastery, who is often mentioned as a patron of the Arts, was also an expert on glass-making.

"Fuit non ignorus artis et omnis quae ex vitro fieri solet compositionis."

In the year 1276 there is a record that Bishop John had glass windows made for the St.Vitus Cathedral in Prague with scenes from the Old and New Testaments. Soon glass-makers, mirror-makers and coral-makers settled in Prague. In 1548 they were accepted into the venerable guild of painters; in 1390 a glass-cutter is known among the court artists of Queen Elizabeth, and in the same year Václav Klatovský "vitreato et pictor" — the glass-maker and painter — applied for citizenship in the Old Town of Prague. In 1408 a glass-painter, called Borsho, is mentioned in the list of property owners.

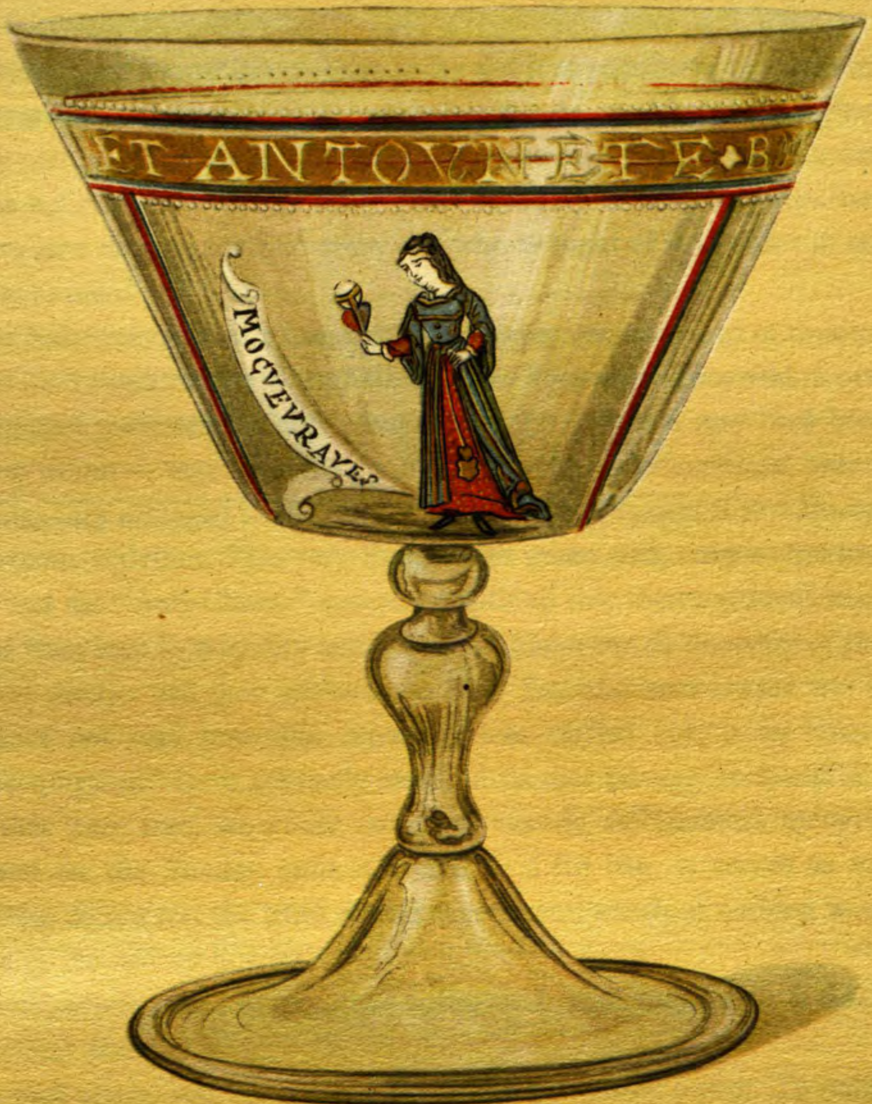
All this proves glass-making was an old Bohemian art, an old craft, and though the historians have documents stating that the first Bohemian glass-houses were set up as late as the fourteenth century in the dukedom of Vimperk — or, according to a North Bohemian legend, not far from Castle Tolstejn, — this represents a mere mechanical interpretation of historical records, adding only local-patriotic or ethnical details to the real facts.

Do they tell us anything about the real conditions of this branch of industry which maintained itself for centuries in the deep forests of the border areas of the old Kingdom?

Zigmund Winter, in 1906, wrote the following in his work about "Trade and Commerce in Old Bohemia."

"The trade of the glass-makers made much progress. Until the year 1419 more than twenty of them are named in Prague sources, seven as citizens of the Old Town; the first of these, glass-maker Hainczlin lived near the church of St. Valentine. The only difficulty is to know whether these were glaziers or glass-producers — in Czech, German and Latin the designation varies. In any case, the elders of the community showed much interest in this trade; for when "glazier" Mikulas applied for citizenship in 1391, he was granted it without any of the usual formalities and difficulties. This applied also to similar cases in Hradec Králové and Budějovice. There are frequent reports of glazed windows in churches, monasteries and town halls. As the wealth increased more and more glass-makers, including glass-painters, were mentioned; here and there also a Jew, as, for example, in Náchod in 1529.

Glass was melted in the border area, where they produced the so-called "forest-glass". Glass-houses existed on the domain of the Rožmberk family and near Falknov. Gradually this industry left the border area and suddenly the Prague records in 1443 contain a "Petr vitra parans" and a Matthias with the same title.



COLOUR PLATE XXIX

His glass-house at the "Schinder" Gate in Prague has caused much dispute among historians. Some were of the opinion that around Prague there were no rich forests to ensure fuel for glass-houses. On the other hand, it is said, that sufficient cheap timber was floated down the river Vltava to supply the glass-houses; for also in Vienna which was never close to cheap sources of wood there were glass-houses in 1486. There are historical records for the glass-house of the Dominicans at the St. Agnes Monastery and they might well have been a lucrative source of income for an individual a hundred years earlier.

Rock-Crystal Leads Us Along the Right Track. Let Us Follow Its Overgrown Path

Why was rock-crystal such a great favourite and why was it so popular as raw material? It is a natural mineral, clear, transparent, and incomparably better than the old, usually coloured glass or the medieval green-brown, badly melted "forest-glass". Its natural formations were a cause of general delight to all.

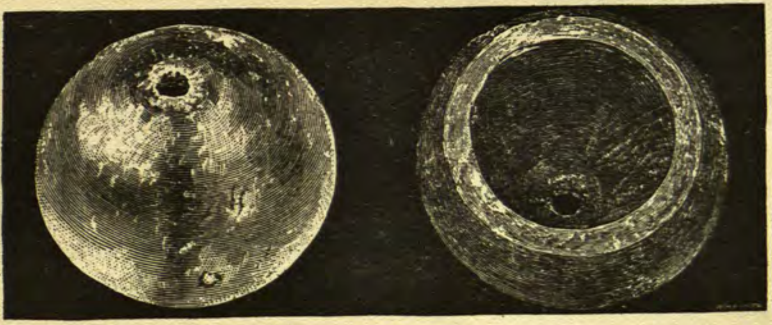
Moreover, it was believed that — like many other stones — it possessed supernatural, protective powers. Who knows how this superstition arose and who thought of it in order to sell this expensive material more easily to men?

Already Pliny the Elder related that a certain healing power was contained in rock-crystal. Of course, there was no lack of such superstitions in the Middle Ages. Rock-crystal was said to protect from thirst. There was no abstinence movement at that time; and so the inventors may have been some Oriental caravan leaders from whom — together with the crystal — the crusaders might have taken it, with all the many other things they managed to steal in the Orient. They brought it to a Europe that was priding itself on its virtuous activities. This very Europe was green with envy at the incredible progress of the "heathens" and the "Anti-Christs" compared with all that their continent knew which had remained clumsy and been kept in stupidity and ignorance under the dictatorship of the Church.

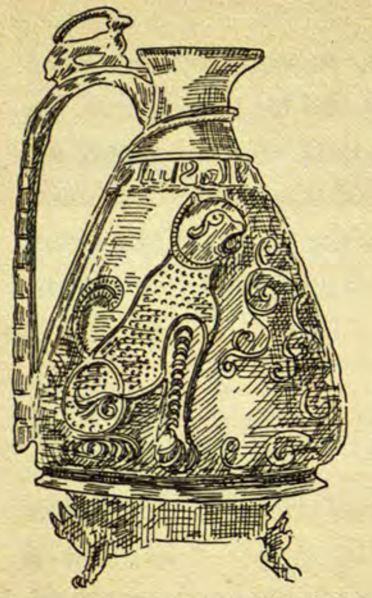
Now the medieval witches had their sabbath; on Holy Saturday rock-crystal was used to light the "sacred fire". I have not read how this ceremony was carried out; it is, however, impossible. The originally "metaphysical" force gradually assumed further powers: rock-crystal can keep everything "fresh". If that were true, we would not need electric refrigerators today; it would suffice to place rock-crystal on the Sunday joint. Covered in a fur bag, it served as an amulet against bleeding — but please do not test the truth of this experiment, which, if nothing worse, might end in a blood transfusion in the nearest hospital.

At other times rock-crystal cured dropsy, then again tooth ache; and how is it that today's stomatologists are still ignorant about this ...

In other words, rock-crystal was given every possible supernatural power. To judge by the finds it seems that it was not worked very frequently in Antiquity. Perhaps the explanation is that the skill at making and cutting as well engraving glass was so magnificent. Therefore rock-crystal might have seemed superfluous and only minute objects have been found, few of which originated during Antiquity. C. J. Lamm complained that the name "Crystal", which from the eighteenth century was



109. Hairpin studs of rock-crystal, found at Mycea. Reproduced from the work by Dr. K. Schuchardt.



110. Magnificent Egyptian jug cut from rock-crystal in the 10th century A. D. Reproduced from C. J. Lamm, vol. II.

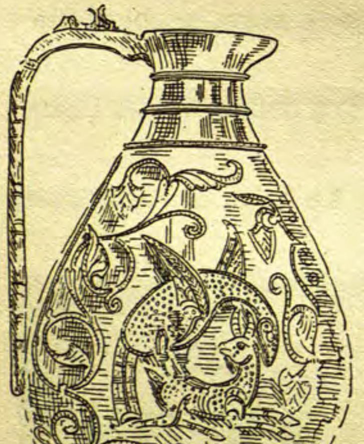
beginning to be used for crystal-glass, had a double meaning and that this complicated an exact analysis of the texts; equally misleading was the Arab word "billaur" which also applied to glass and to rock-crystal. We know that the Orient preferred coloured stones and glass to clear white which did not please the Orientals' love of colour — a love which seems to have been characteristic for a whole epoch in the development of man.

But we know a square bottle with a profiled neck which might be dated back to the Roman epoch. Lamm, in volume II, p. 180, is of the opinion that this piece points to Egypt, whereas Professor Zahn sees Chinese work in it.

Further two magnificent lions' heads are known which must once have decorated a throne, and which now decorate a glass case in the Cluny Museum in Paris. Experts assert that they originated during the fourth century before Christ. Then there was a long interval until the Merovingian finds (fifth to eighth century). These were simple, smooth balls which like other jewels were made spherical. The opinion that the development of the special art continued without a break can therefore be neither confirmed nor refuted.

At the time of the Carolingians, i. e. about the middle of the eighth century, more complicated things were made of rock-crystal. Outstanding among them is the "Susan Tablet" of the Waulsort Monastery on the river Maas, which today is in the British Museum in London. A square dish from the end of this epoch belongs today to the church treasures at Osnabruck, where it is used in the twelfth century Ostensorium.

After this short interlude the European treatment of rock-crystal ceased almost entirely, except for the so-called "Mügelsteinchen", little spheres cut by hand to a round or oval shape, which were used as decorations for book bindings and as lining for shrines of relics. From the tenth to the twelfth century the East occupied itself with this art, reaching a hitherto unsuspectedly high level of development. Entire vessels were made of rock-crystal. These belonged to the exclusive treasures of the churches, to which they were taken during the Middle Ages; as the result of the almost unlimited power of the Church at that time they were preserved.

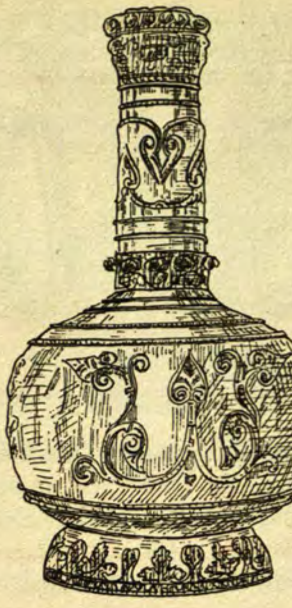


111. The counterpart to the previous bottle, cut from rock-crystal at the court of the Fatimes at the same time.

It is in the French cultural sphere that it is seen most clearly that crystal-cutting returned to Europe only during the thirteenth century. We have a record, dated 1260, about the skilful Paris masters as well as the circumstance that these masters formed a special guild in 1292. Unfortunately, there is no definite proof that the preserved samples belong, indeed, to this period and place.

Burgundy at that time did not belong to France. Here we find that rock-crystal was being worked on a large scale, beginning in the fourteenth century. Even large vessels were created. Goldsmiths, too, reached a very high artistic level in this area. The Dukes of Burgundy began to collect truly royal treasures in their courts at Dijon and later in Flanders. They are said to have belonged to the largest and most precious in the whole of Europe. Jewels of all kinds, beautiful paintings, precious textiles and all that men's hands were able to create in the most perfect forms was collected here. The crowded chambers and halls of the Burgundian castles presented soon a unique wealth which was continuously increasing. Undoubtedly, many objects of these world-famous collections were made in Burgundy itself and among them the most outstanding are the vessels of rock-crystal.

The Italian Renaissance developed decorations and form. It far exceeded all previous achievements. Here the deep cut was wedded to the relief cut, to climb, jointly, to the very peak of technical and artistic perfection. The search for and transport of the crystal boulders had to be organised. These druses were imported from the East, as well as from America and also collected in local regions. Not only in Spain and Italy, but also in Bohemia, the Rhineland and the Austrian Alps were such rocks discovered. It is said that the Dukes had special servants whose sole task it was to seek this rare raw material. All works of art of the era bear the signet of some court. For only the secular and the church lords at that time had the means to cover the costs involved in the discovery and treatment of these large-sized stones.



112. Egyptian vase belonging to the Fatimes in the 10th cent. A. D. Cut from rock-crystal. Reproduced from C. J. Lamm, vol. II.

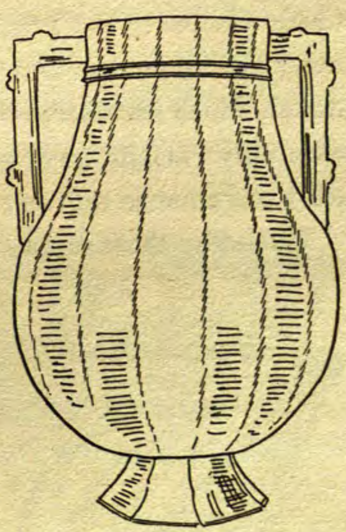
How was it that the ruling feudal lords took such a liking to a material which was so difficult to work? Was it only its dizzy price? It seems that a far more complicated circumstance was decisive: i. e. the contemporary taste for extreme virtuosity in artistic expression, a taste which is typical for the whole of Antiquity.

The centre of these products — regal in every respect — was Milan. The Duke of Florence had vessels of rock-crystal made by the Carrioni family who worked there during the last quarter of the fourteenth century. Even the Dukes of Mantua, Turin, Madrid bought their products. The Bavarian Dukes tried to persuade the Saracchi family to migrate to Munich. And Emperor Rudolf II invited Ottavio Miseroni to Prague in 1588. A certain Annibale Fontana is named as the founder of the Milan school.

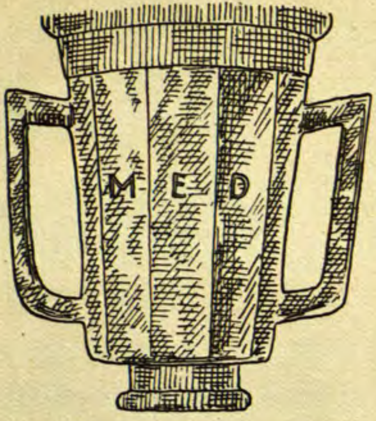
Most of our information today is of the Saracchi family. We can gather from a contract with a Bavarian Duke what their workshop must have been like:

There it stands written that Stephan was occupied exclusively with the rough chiselling, whereas John Ambros shaped the form. He was entrusted with the often very complicated task of designing the vessel. The third brother, Simon, whose wages exceed those of the first two, devoted himself to ornamentation and figurative decorations.

There were also many such stone cutters in Florence. Rudolfinian Prague became the heir to this feudal, extraordinary costly branch of art. Rudolf II, soon after ascending the throne, turned his back on the matters of state and delved deeper and deeper into the problems of science and art, among which no insignificant place was reserved for stone-cutting. Masters from the Netherlands, Italy and the German lands came to Prague Castle and created a special style which suited the

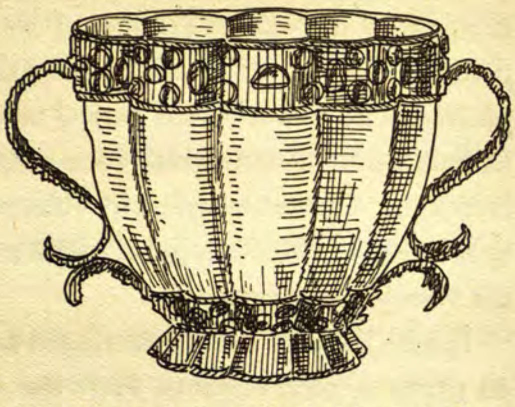


113. Two-handled Burgundian vase, cut from rock-crystal during the 15th cent. Height: 40 cm. Vienna Collection. Reproduced from C. J. Lamm, vol. II.



114. Two-handled medicine bottle, cut from red jasper, belonging to the Medici family (Florence, 15th cent.). Reproduced from C. J. Lamm, vol. II.

royal collections, for these were assembled according to a clearly recognisable system. Emperor Rudolf II. was not only in love with Antiquity — after all, he had acquired one of the most famous of Augustine cameos — he also had a certain system in painting; this is seen from his preference for Dürer, Correggio, Brueghel and Titian. The Rudolfinian style is clearly imprinted on the works of the stone-cutters and goldsmiths of the period. The Prague court workshops coined their own style. This shows itself, for example, in the harmonious shades of the enamel on the jewels.

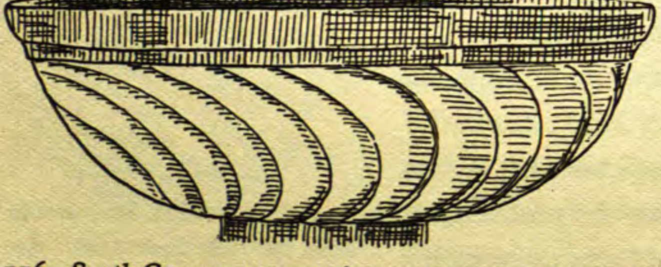


115. Byzantine cup of cut rock-crystal from the 10th cent. set with silver. Reproduced from C. J. Lamm, vol. II.

Ottavio Miseroni came to the Prague Castle in 1588. Apart from his workshop he set up a watermill in Bubeneč which continued to function long after his death. His creative abilities were manifold: he made cameos from Bohemian semi-precious stones and shells, vessels and little altars and also precious miniature objects of rock-crystal; one day he worked gold, the next he designed enormous mosaics. Miseroni worked thirty years for his royal patron, Rudolf II, and for the latter's childless brother Matthias and their nephew Ferdinand II, and was appointed to the rank of Keeper of the Royal Treasure. As he himself admitted, during the Thirty Years' War he several times saved the immense treasures of his masters from destruction, and it may have been these services which enabled him to make his son Dionisio first his assistant and later his successor. The latter began his career, as records confirm, with fifteen gilders monthly.

This Dionisio, born after 1600, entered the services of Ferdinand II in 1623 and in 1630 became the Keeper of the Royal Treasure. In this function he had to carry out several tasks: He built the Castle Chapel in the Prague Castle, took part in planning the water system of the Castle, built the Mary Column in the Old Town Square and projected the navigation on the river Elbe. All these things, which later fell to the responsibility of a number of ministers, he did, as it were, off-hand. These were only "details". For his life task was the cutting and engraving of stones. For 12 000 gilders he cut a real emerald into an enchanting little bottle for the extreme unction.

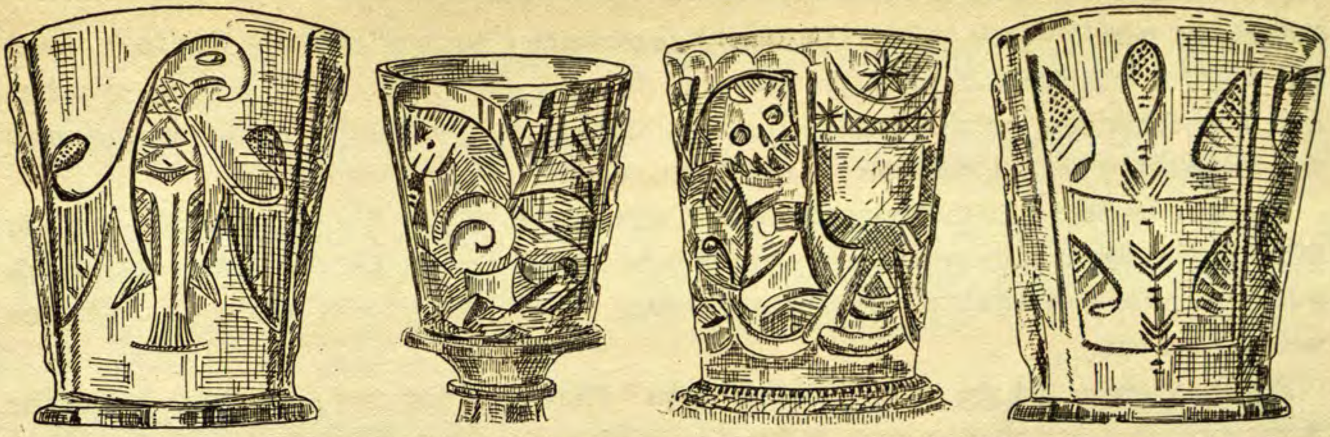
Wherefore those numerous side jobs? The Emperor paid badly. By the time of his death Dionisio had received barely half of his fee for this little bottle and that in instalments.



116. South German cup, cut from rock-crystal, hemmed with enamelled gold, 16th cent. Reproduced from C. J. Lamm, vol. II.

Dionisio worked all possible stones: onyx, lapis lazuli, jasper, agate, topaz and, of course, rock-crystal. He worked not only for the Emperor, but also for Charles of Lichtenstein and for foreign monarchs. He created collossal, quite incredibly large pieces as, e. g., his famous pyramid whose socle alone was one metre high.

One could fill pages with the descriptions of



117. The so-called "St. Hedwig's beakers", magnificent Egyptian cut glass from the 11th to 12th cent. A. D. Reproduced from C. J. Lamm, vol. II.

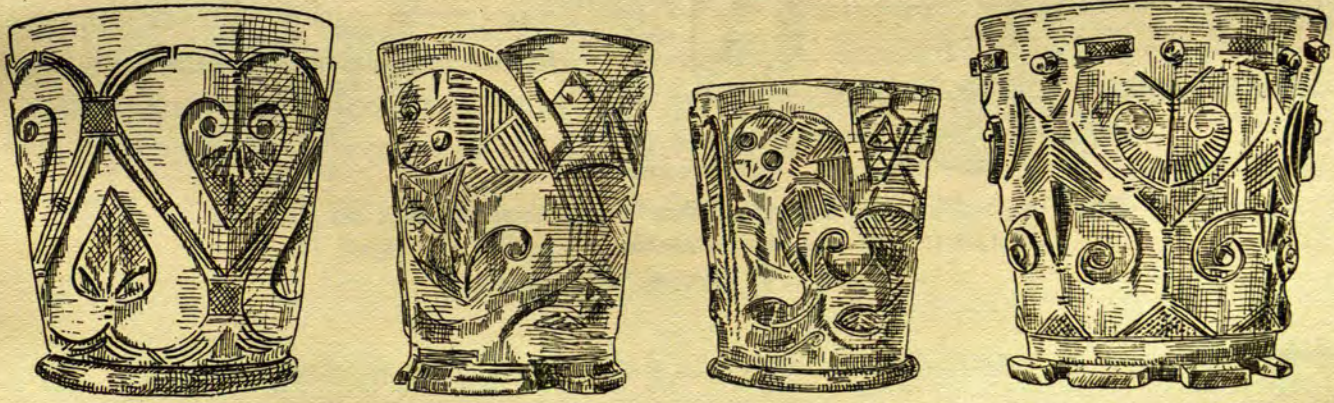
his life work. Dionisio was one of those great artists of the Italian Renaissance whose unbounded creativeness, admirable many-sidedness and sensitive assimilation to the prevailing taste of the time were appreciated in the North of Europe even at the height of baroque. Dionisio also had a son, Fernando Eusebio, who later found his own means of expression, suited to his time.

Among the foreign masters at the Court of Rudolf II there was also Kaspar Lehmann, of whom we shall have more to say because it is he who stood at the cradle of the refinement of Bohemian crystal-glass and whose creations opened a new chapter in the history of glass-making.

Now Something About the Raw Material and Its Treatment

Rock-crystal is a worse heat conductor than glass; touch creates the impression of cold. Stripes and cuts ("feathers") can be seen in it which cannot be explained by external influences and which would be unthinkable in glass. And so one question inevitably forces itself on one:

How could the many known and unknown workers, whose number reaches the hundreds, master the infinitely difficult task which this brittle, immeasurably expensive material set them? Their employers, according to the taste of the time, demanded to be given highly artistic and ornamented vessels made from these stone boulders. Consider that quartz has the seventh grade of hardness, diamonds the tenth, glass, on the other hand, only the sixth. The admirable results of this skill were



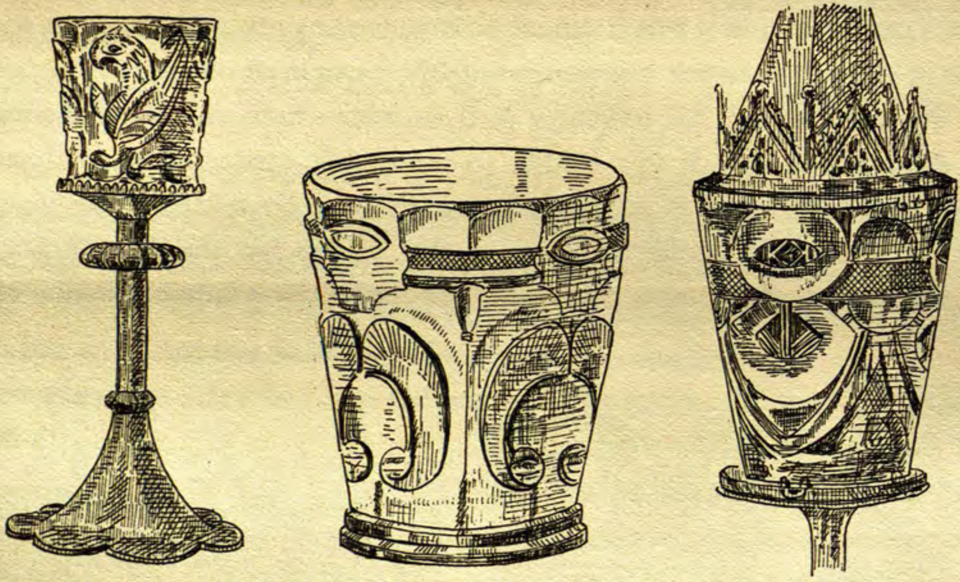
118. The so-called "St. Hedwig's beakers", magnificent Egyptian cut glass from the 11th to 12th cent. A. D. Reproduced from C. J. Lamm, vol. II.

achieved by minute wheels and various shaped implements ("pointers") whereby the whole vessel was rapidly rotated after dusting with emery or diamond powder. Originally a tightly-stretched arch kept the drilling machine in circular motion. The crystal was attached to it, and the implement was controlled by hand. Later it occurred to them to use water power as propulsion.

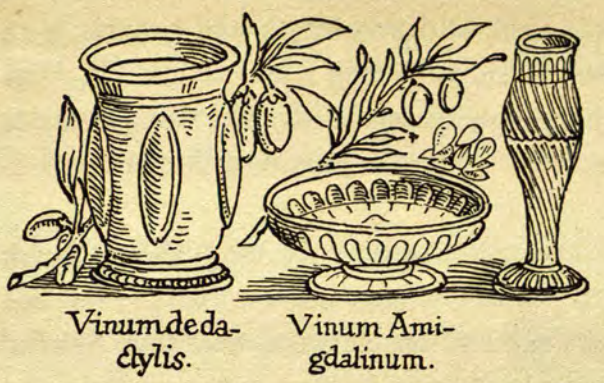
A picture by Škréta in the Prague National Gallery shows us how this work was carried out in Miseroni's workshop at the royal country seat at Bubeneč, near Prague. The crystal was stippled with a diamond point with which, similar to bronze chasing, a design was made or subsequent corrections were carried out.

But from where did the crystal boulders come? Pliny says that they came from India. The Arabs wrote that such blocks were to be found in Arabia and in China. Since the fourteenth century, however, such pieces were exported from Europe to Cairo, and so it seems that they were found in the Pyrenees, the Alps and finally also in the Bohemian mountains.

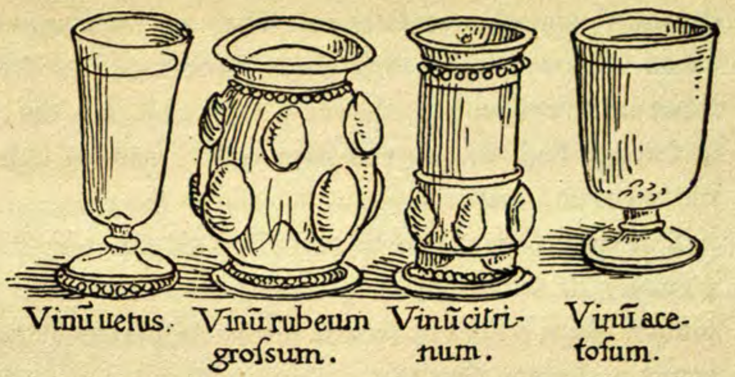
It is not quite clear how valuable such a creation was. Rudolf II paid Miseroni for each vase half a million gilders. Unfortunately there is no indication how much that was or how much could be purchased for such a sum. Such knowledge would be necessary to form some conception of how much had to be stolen from the exploited masses of the people to enable a nobleman to have a vase of rock-crystal on his table. It would be necessary to know the wages of a worker of the time to gain a correct impression. These incomparable works of art prove to us today what abilities man developed in this — I am tempted to say — side-line, as represented by the buildings of the old cathedrals, the pyramids and the enormous gold dishes, which bear an eloquent witness to the enormous exploitation of man by man.



119. The so-called "St. Hedwig's beakers", magnificent Egyptian cut glass from the 11th to 12th cent. A. D. Reproduced from C. J. Lamm, vol. II.


Vinum de dactylis.
Vinum Amigdalinum.

120. Shapes of wine glasses from the 16th century. Based on an old woodcut.


Vinū uetus.
Vinū rubeum groſsum.
Vinū citrinum.
Vinū acetoſum.

121. Shapes of wine glasses from the 16th cent. Based on a contemporary woodcut.

THE "BOHEMIAN CRYSTAL" MAKES ITS FIRST APPEARANCE

I AM CONSCIOUS of the fact that the previous chapter which was to serve as a kind of introduction to Bohemian crystal glass encompassed too much; those were the general currents which, on a wider scale in the world, and on a narrower one in Europe, preceded the birth of crystal glass, a material through which Bohemia has made a positive contribution to the development of world culture.

To this day it is not known when, how and where in Bohemia was its origin. Most probably it was immediately before or during the Rudolfine epoch; but we have no idea where the first melting took place.

What exactly is this crystal glass? An artificial raw material like every other glass, but its open and hidden character most closely approaches rock-crystal. Soon after the Thirty Years' War these properties helped to break down the exclusive monopoly of the thin upper strata of reckless feudal lords; and crystal glass became, even if a rare, an attainable raw material for the people's industry in Bohemia: the famous glass industry.

The direct merits of this raw material helped Bohemian glass to reach a monopoly position in the world for the next two centuries; much of this is due to the work of the so-called "glass companies" which evolved a special system of distribution.

If we were to recapitulate all the preserved records about the numerous glass-houses of old days we would merely have to copy the careful collection of the two historians of Bohemian glass: Dr. E. Schebek (who published his work in German) and František Mareš (whose book is written in Czech). Both of them have gathered their extensive material most carefully and presented it in the form of a chronicle.

What was the most fundamental point in those works-contracts and in the other documents of which such large numbers have been preserved?

Bohemian Church Windows

§ 1. The most essential, perhaps, were the facts related by Aeneas Sylvius in his well-known travel account which dates back to the sixties of the fifteenth century:

"I maintain that in my time no kingdom in the whole of Europe had such magnificent and beautifully decorated churches as Bohemia. They are immeasurably high, of daring length and breadth, with vaults of stone blocks, their altars glistening in gold and silver, containing sacred relics. The mass robes are strewn with pearls, every garment is rich, the church implements costly. The daylight floods in through high windows of great width, made of light, artificially made glass. And that not only in the towns and market centres, but also in the villages."

This testimony should be accredited all the more for having been written by the highest Church dignitary. If the historians possess a document about the Bohemian glass-houses, which is but one century older, it does in no wise justify the glazed windows in the village churches, since from Sylvius' report it is quite clear that nothing similar was to be seen anywhere in Europe, including France or Italy. That means that the glass industry in Bohemia must have been of great significance and extent in 1451, that it must have existed long before that date and that it served the religious world generally.

The First Glass-Houses

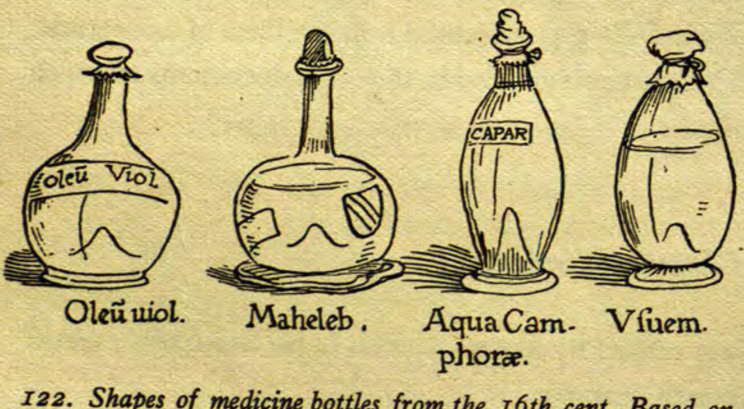
§ 2. All that is said to have originated from the Vimperk domain where the first glass-house (actually "glass-maker's house") is recorded in 1359. Can that be so? Or was it perhaps in the forests of the lords of Rožmberk in the glass-house on the lower reaches of the river Vltava? Or from the glass-house at Chřibská which a certain Lord Jindřich Berka of Dubá and Lípa mentioned on a 1418 parchment under ten seals? I would recommend this document, containing the first mention of Tolštejn Castle, to the archeologists for further excavations. For how else could we find out the real birthplace of the ancient Bohemian glass industry? Or did it perhaps originate elsewhere? The path is overgrown and hidden by the long years; we must label it impassable for the time being.

The Glass-Houses of the Sixteenth Century

§ 3. Even from these insufficient documents do we know that in the sixteenth century the number of glass-houses increased enormously. A contract from the year 1575, which has been preserved, tells us what such a glass-house looked like:

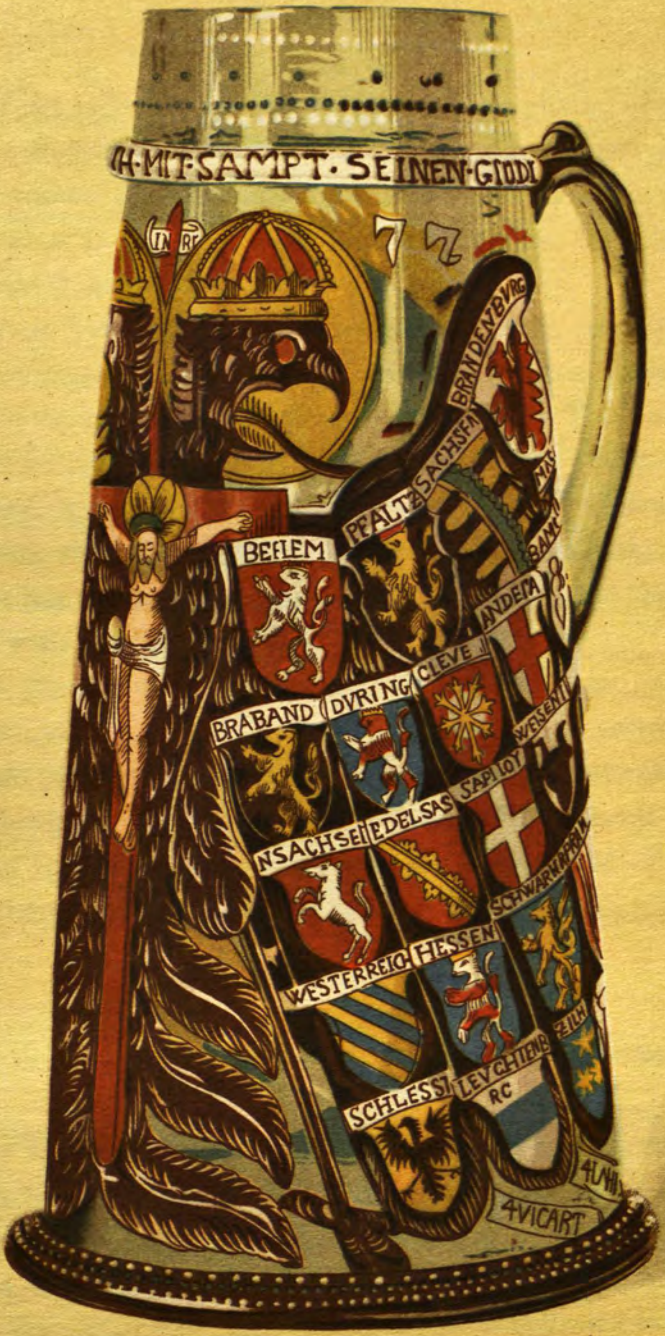
"To erect a glass-house four hides of land, together with the forests on them are sold. Fields and meadows belong to it, so that the new glass-maker may cultivate them for his own purposes, and so does the entire windfall and fallen timber . . . Let him keep four or less 'ash-burners' who are to burn the necessary ash from the forests of two estates."

The glass-maker also had the right to brew beer for himself, his workers and servants, without harming the Imperial pocket; he was further allowed to use the waters of the stream "for the erection and driving of a stamp-mill and for the irrigation of his meadows, but was not allowed to fish in the same . . ."



122. Shapes of medicine bottles from the 16th cent. Based on a contemporary woodcut.

On the other hand, he committed himself



COLOUR PLATE XXX

and his heirs to paying an annual rent of 20 thalers at 36 groschen and one thaler forest rent for each "ash-burner". Moreover, he had to sell the lords of the estate a "chest" of bull's eye panes for no more than four thalers and add to it, free of charge, a "threescore" wine glasses, called "Ruren". He was subject to the lord but freed from all services.

The Old Technology

§ 4. This short extract of the rent contract already gives a clear picture of the feudal glass manufacture. And when we read the description of the Preitenštejn glass-house, belonging to František Rückl, which was written in the last years of the nineteenth century, we shall see that apart from improvements in the furnace which, in contrast to the older German one, was called the "Bohemian Furnace" the old glass-house already contained all the basic features:

There were the "ash-burners", as well as the stamp-mill driven by water-power, the entire production of potash — that most important component of our hard "potash" glass — which was closely connected with the important work of the "ash-burners" in the forest. Their number determined the consumption of timber on which the entire productivity depended. The stamp-mill gives a clue to the preparatory technique of grinding quartz flints for the "batch"; after cleaning they were raised to white heat in the cooling oven, were then burst in an enormous water-tank, usually built of stone; finally they were sorted according to purity, poured into the stamp-mill and there crushed to powder by a beam that was covered with iron and driven by water-power.

There is no doubt that the glass furnace was no longer divided into three parts, since the existence of a water stamp-mill is mentioned in the text. The flints were no longer sorted to be mixed with the "ash" to produce the impure "frit" — that old raw glass which has been discussed several times. They must certainly have understood how to win pure potash from the ash in the stream, so that we may rightly assume that the former furnace, apart from the arrangement of the hearth, was very similar to the later furnace; there were no longer two sections for the double melting as had previously been the case.

The Glass-Cutter and the Feudal Limitations

§ 5. The records mention a glass-house whose patron (not lease-holder) returned forty-five years later from a journey through Italy, Spain, France, and the Netherlands with a cutter whom he settled on his domain under the conditions that he would teach the local people his craft. This man is said to have introduced glass and stone cutting to the Hirschberg Valley near Gryfin. A pre-condition to this undertaking was the production of clear glass that could be embellished in this fashion.

Other contracts include, apart from the brewing right, also the right to fish, to set up a saw-mill, to establish a wine cellar and sell liquors, the right to bake and slaughter with the permitted sale of the products. For all these tasks against payment of a rent, the feudal lord freed the serfs on his estate from their statute-labour, not, of course, from bondage. "Only the hunting right is to remain untouched," one of these contracts on forest rights concludes.

Elsewhere (at Falknov) we read that permission "to catch birds and trout" in the stream was granted. The glass-maker could sell beer and wine, brew the beer himself, but had to buy the malt from the lords and pay an annual 10 Kopas* of heavy coins and 2 Kopas for the fishing rights. Here we are dealing with glass-maker Paul Schürer and with a contract from the year 1530, after the death of Beatrix Kolovrat of Dubá and Lípa; the document is signed by Zdislav Berka.

The Glass-Maker — Nobleman

§ 6. The said Paul Schürer seems to have been the most skilful glass-house master (i. e. manager of the glass-house). He came from Saxony, and Emperor Rudolf II raised the widely interrelated branches of this family to the rank of the nobility with the title "of Waldheim". These "noblemen" succeeded in avoiding the usual rent and they bought and then sold glass-houses together with the entire estate forests until the year 1279. After numerous court proceedings over differences between this family and third persons the Emperor himself was forced to protect the others from the suspicious shrewdness of the Schürers and must have had good reason for raising them to the nobility. Schürer's heirs then formed one of those glass dynasties as later the Preussler, Jancke, Riedl, Palme and Kittel families.

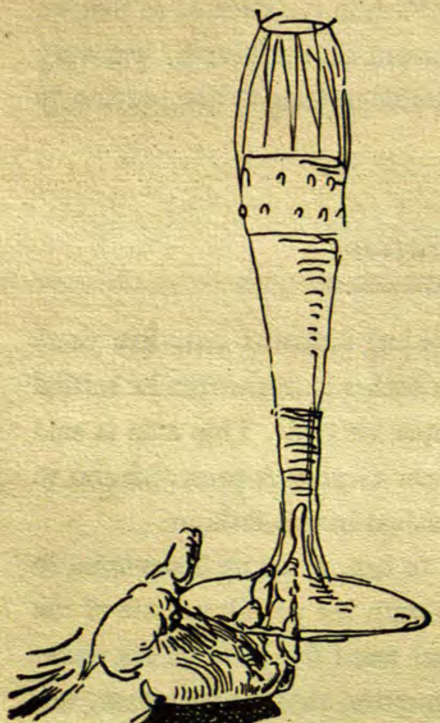
Italian Glass-Makers in Bohemia

§ 7. At the same time there is a remark in the documents of the Bohemian Chamber from the year 1570 about the decreasing forest wealth of the kingdom. Later more serious and insistent words were spoken on the same subject when the timber crisis was brought closer in view of the constantly increasing number of glass-houses.

Petr Vok of Rožmberk assumed the control of the Vimperk estate in 1562. And so we read among others in the orders:

" .. according to patterns submit articles of beautiful, thin and light glass . . . they are not to be sandy . . . they should not contain either sand or stone . . . (the distillation glasses) of good, not of quartz glass . . ."

On August 17th, 1557, Vilém of Rožmberk informed his officials that he had granted permission to two glass-makers to set up glass-houses in suitable spots and to work therein. Those were the Italian glass-makers and they arrived at the very moment when suddenly the clear, colourless, crystal glass made its first appearance. Maybe, here we have one of the lost tracks.



123. Albrecht Dürer: "Cudgel-shaped goblet" in the hand of Esculapus. Drawing from the years 1502—04.

The Different Kinds of Products

§ 8. In the year 1594 there is more exact information about the products of a glass-house near Nové Hrady: distillation glasses, white, striped glasses, "Angster" glasses, bottles and jugs, large glasses with the seven Electors and the date, glasses with coats-of-arms, with one or two emblems, dappled glasses, large glasses, small glasses, large and small candlesticks, small barrels, and different kinds of bull's eye panes. Glass-painting was carried out either with oil colours or with mastic colours. Some glasses were decorated with full or semi-gilding and with designs.

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* Kopa — an old Czech coin = 60 Groschen (Translator's note)

The Income of the Glass-Houses

§ 9. We read the following about the prices:

"... for diverse glasses, tin covers and screws delivered by the glass-maker, painter and jugmaker for 797 gulden* and 24.5 kreutzer.** Price of the goods taken over from the Rožmberk estate: 191 gulden, 22 kreutzer. Together 988 gl. 46.5 kr. The glass-house had the following expenses:

Wages for the glass-makers, painters, jugmakers: 345 gl. 56 kr. For gold, tin, lead, blue and brown colour, ash, salt, breakages and wood: 121·38 gl.

The weekly wages amounted to 119 gl.; making a total of 586.343 gl. This left a clear profit of 402 gl.

The master glass-makers were paid according to a piece rate as well as quality; the assistants by the week. The glass-house master received weekly 1.10 gl. which brought him an annual income of 60.40 gl., apart from what he earned by his work. In the season 1608—9 that amounted to 101.55 gl. The clerk also earned 1.10 gl. weekly. The better sorts of glass which were best paid, were, of course, made by the glass-house master himself and by his relatives.

The "Bohemian Crystal"

§ 10. Fr. Mareš says on p. 26:

"When in 1558 the news spread that the Dukes of the Empire would make their way through Jindřichův Hradec and spend the night there, the magistrate there, Sčestný of Pleši, — in sending this information to his master Joachim in Jindřichův Hradec—asked to be allowed to purchase crystal-glass for these noble lords, because there was none to be had on the spot; and he asked him to transmit the necessary financial means."

This is perhaps the first mention of Bohemian crystal glass; it comes from the year 1558 ... Or should one understand Venetian under the "crystal" glass?

The Price of Glass

§ 11. What did glass really cost at the time? The glass-maker Valentin in the Prague Malá Strana district supplied the palace of the Rožmberks on the Hradčany Hill with "little panes"; for each pane of good Venetian glass he received four small groschen. The entire bill amounted to 480 groschen. In 1598 the same customer paid a certain Gerhart for Venetian glass 7 kopas 25 groschen; they paid a Prague Jew, Jacob, 148 kopas for all kinds of crystal glasses (!!) In 1614 the glass-cutter David Engelhart in Prague received 150 kopas for the cutting of various glasses and Venetian plate-glass. He counted the engraving of the coat-of-arms of the Schwanenbergs 9 kopas and that of the Last Supper on a Venetian goblet 20 kopas. The family of the Duke Berthold owned a few Venetian escutcheon glasses from the year 1602. A small cut glass cost 1.45 gl., a large one with the decoration of serpents 5 Rhinish thalers. (Mareš p. 28.)

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* Abbreviated as "gl."

** Abbreviated as "kr."

Production Increased in the Sixteenth Century

§ 12. Whereas we know of four to six glass-houses in the fourteenth century, there is mention of six to eight in the fifteenth century; and in the sixteenth already four-and-twenty had sprung up in Bohemia which, apart from window panes, made also hollow glass, lamps and mirror-glass. Coloured glass was produced side by side with the green "forest-glass". Indeed, different sorts of magnificent, really luxurious glass-ware was produced, whose attraction was increased by means of opaque fired painting, diamond cutting, tin stripes, gilding and metal covering.

The panes were either small (a "chest" for four thalers), transparent (a "chest" for 21 thalers) or rhomboid (10 thalers a "chest"). Of the hollow glass production we know wine and beer glasses (the so-called "Ruren"), "Angster" glasses, bottles, goblets, little barrels, lamps and "half-measures". In 1617 a Prague glass-maker's store contained seventy crystal glasses with lids, each for 24 kr.; "Engstel" glasses at 30 kr; 3 400 ordinary Bohemian glasses at 28 kr. per hundred and 400 ordinary crystal glasses at 20 Rhinish gulden per hundred.

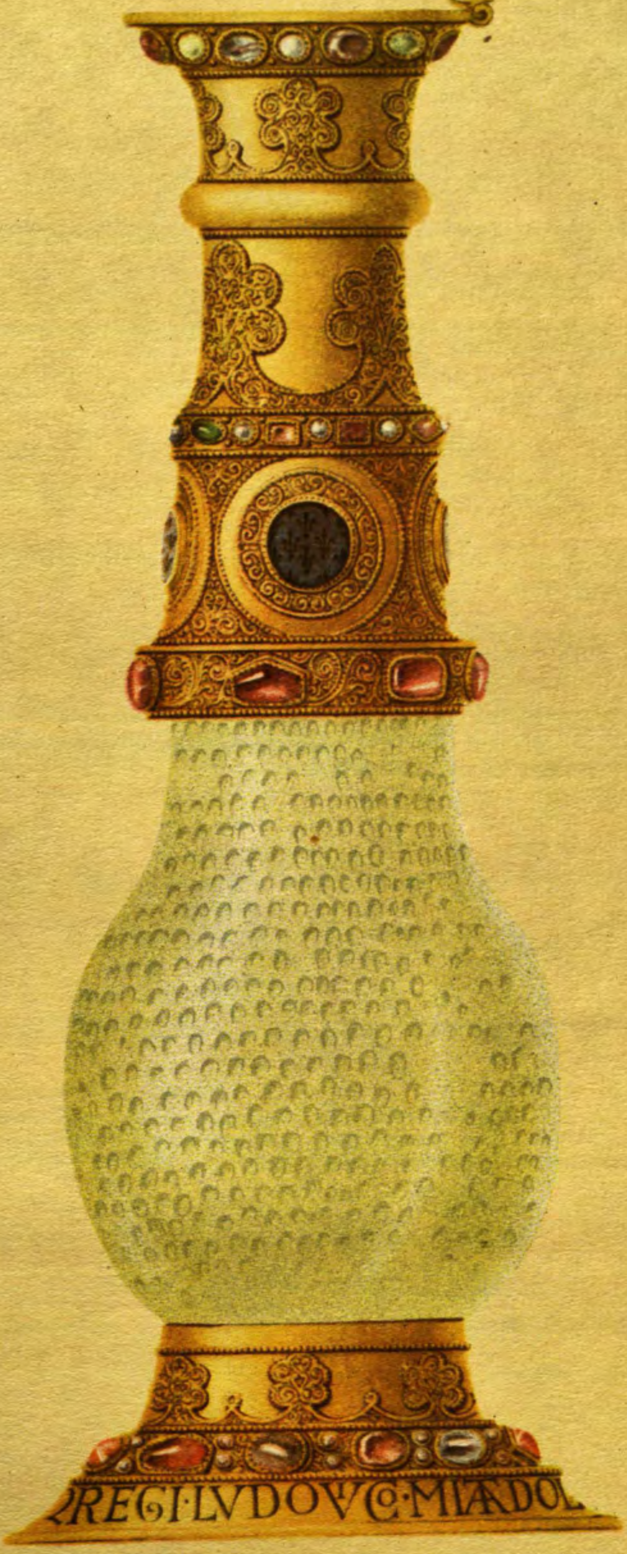
Glass Painting and Window Glazing

§ 13. It is reported that glass-painting, which has already been mentioned in connection with the development in the East, found its way to Bohemia as late as the sixteenth century. It is said to have come from Italy. That assertion does not seem to contradict the fact that it made its home here much earlier. For the reference refers to the newly-invented enamel colours. The statute of the Prague painters' and glaziers' guild states in Article 11 that the journeyman was to paint a picture of the Virgin Mary with the Christ Child for his qualifying test. That was then to be fired into the glass in such a way that the colours remained fresh; then it was to be set in glass, five ells long and one ell wide and the whole was to be hemmed "as it hoves" with dots.

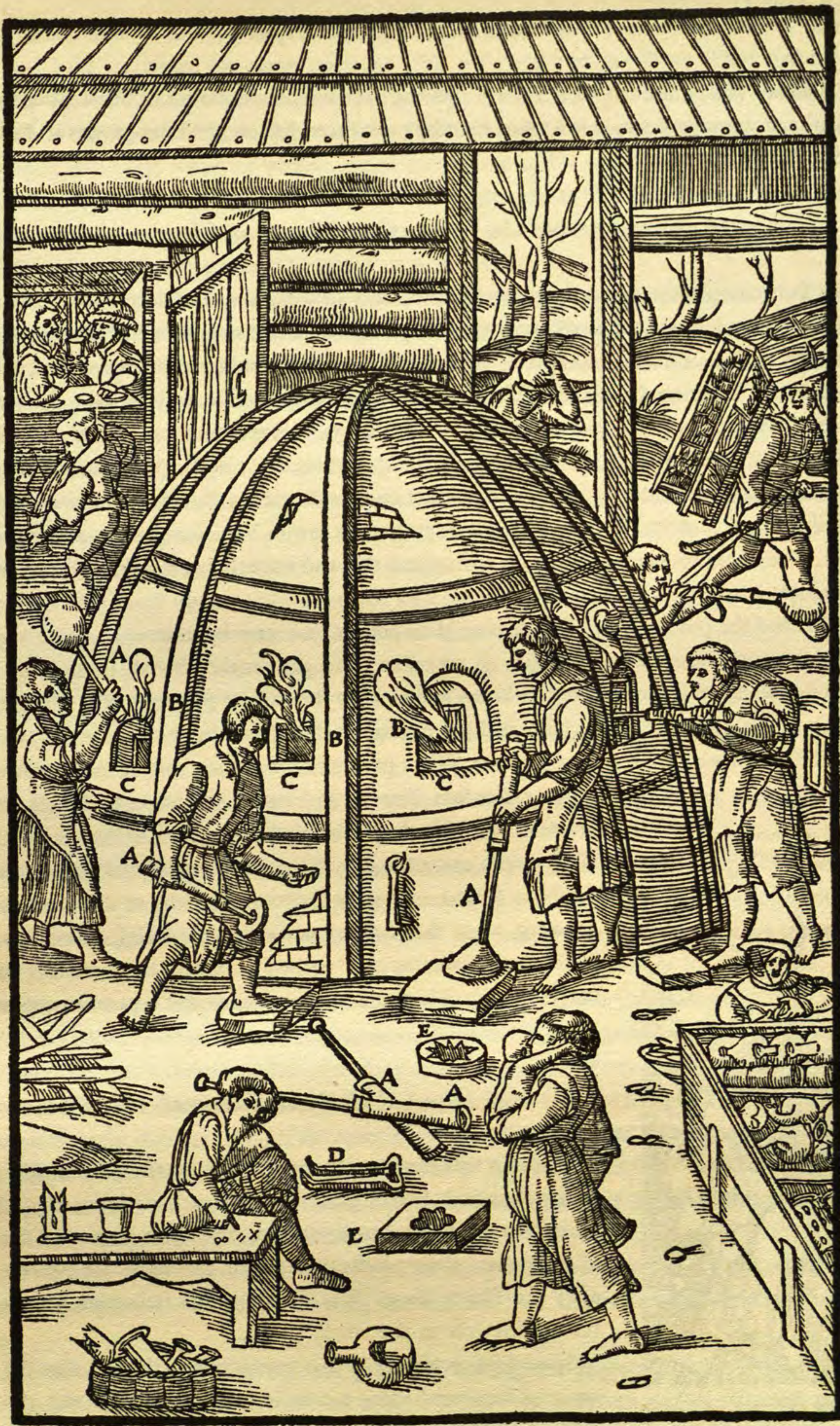
In Article 13 it is stated that the glass-maker's assistant is to produce a frame, $^3/_4$ ell long and 1 ell wide, and is to insert 56 little bull's eye panes whereby a whole pane should be fitted into each corner and the "dots are to be even and smooth everywhere, well set and fixed with tin."

Mareš recalls the glass-maker Abraham in Třeboň who, in 1602, sold Petr Vok of Rožmberk four glasses with the Rožmberk coat-of-arms for 2 kopas and 40 groschen.

The "Report of the North Bohemian Arts and Crafts Museum" (1885, p. 73) contains a complaint of a certain Mathesius about the human restlessness which continually thinks out new things, namely the painting of pictures of great lords and their coats-of-arms on white glass which they then have inserted as window panes. He thundered against the indecent pictures on the "welcome" glasses and against the "fools" glasses which a man could barely lift for their great weight.



COLOUR PLATE XXXI



124. Glass production in a glass-house in the year 1550.
Georg Agricola: De re metallica libri XII, Basle, 1556.

"Glasses with White Stripes"

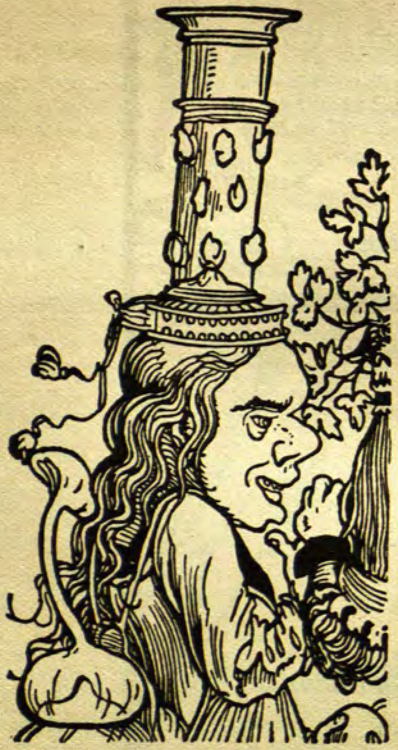
§ 14. Glasses with white stripes were, in Friedrich's opinion, made earlier in Silesia than in Venice. In spite of contrary assertions, it is certain that they produced just as good net glasses in Bohemia as in the South.

Refinement and the Increasing Export of Glass

§ 15. In Bohemia glass was made in white, blue, red and dark colours. The deep-green "forest-glass" continued to be used. For more rapid melting cooking salt was added to the "ash". Decolorization was carried out by means of manganese Mareš assumed that they "painted various leaves and nice lines" on the imported Venetian glasses and refined them before they took to embellishing their own raw glass in this way. Venetian glass long retained its popularity. At important functions it was absolutely essential and large sums flowed abroad, not only for the white, but also for the black (melted) glass. As late as the sixteenth century glass was extremely costly material in Bohemia. Its use was limited to the "noble born" and the rich and pretentious customers saw in Venetian glass the climax and goal of this art. The local production aimed at approaching this and imitating it in colour, form, thin walls and ornaments.

The value and the productivity of Bohemian glass-houses rose, year by year.

In 1494 the authorities demanded only 40 groschen from glass-maker Mertl. In 1530 in Falknov the rent was already 10 kopas, in 1575 12 kopas and in 1599 the sum of 46 kopas. Not only the master of the glass-house but also his assistants and the cottagers who helped in the production, were freed from all kinds of feudal services and serfdom. Glass production became a sort of magic power which granted freedom. Exports increased. According to Mareš, the glass-house at Nové Hrady annually produced glass to the value of 2 000 gl. With prices maintained at this level, a rapidly increasing current of products flowed across the frontiers. It went to the markets at Nuremberg, or to the harbour at Gdansk (Danzig). Glass was carried in wicker baskets or was pushed on wheel-barrows over long distances. We shall have more to say about this type of transport.



125. Hans Weiditz: "Stick goblet" and "Angster-kuttrolf" glass. Woodcut from the year 1521.

And the Sources?

§ 16. In this chapter we have cited extracts from the sources which František Mareš gathered with such praiseworthy diligence. They give a passing, but lively and instructive picture of the period of Bohemian glass production which preceded the famous period after the Thirty Years' War during which Bohemian glass assumed the leading role in the whole world.

Specially noteworthy in this connection is the fact that the significance of local production increased year by year. The rich and beautiful country of Bohemia was, without exaggeration, the heart of Europe. The fact alone that it was surrounded on three sides by foreign nations, forced the inhabitants to protect this crossroad, this treasure house of many rich mines, this fertile land that had been cultivated for many centuries, this early home of the Slavs. They had to defend their country against all kinds of foreign tribes who were thirsting for the natural wealth and the achievements of the people's hands. Not ten time, but a hundred times this country was plundered and laid waste, and every time the people, gifted with an incredible will-power, rebuilt their country, healed the wounds they had suffered and built anew the settlements that had been burnt down. And again and again the foreign visitors gazed on this country and its incomparable beauties with undisguised admiration which never ceased to bear a core of envy.

Nowhere do preserved documents present a less objective picture than in Bohemia.

To judge the conditions of our country long before the Thirty Years' War we can consult the testimony of Aeneas Sylvius. He had no liking for the Czechs. The passion for luxury and extravagance of the churches which he described, stood in crass contrast to the life of the people. It is interesting to read what the German historians first wrote about the Bohemian glass:

"The world fame of the Bohemian glass rests upon the invention of the chalk-glass." But immediately afterwards they asserted that "a great advantage of the Bohemian glass which helped it to its world fame was the enterprise and assimilatory powers of the glass-makers; in contrast to the 'other districts of the Reich' the Bohemians always foresaw the desires and the taste of their clients".

But let us return once again to the Emperor's Court in Prague and look at a man who deserves closer acquaintance since we owe much to him.

KASPAR LEHMANN

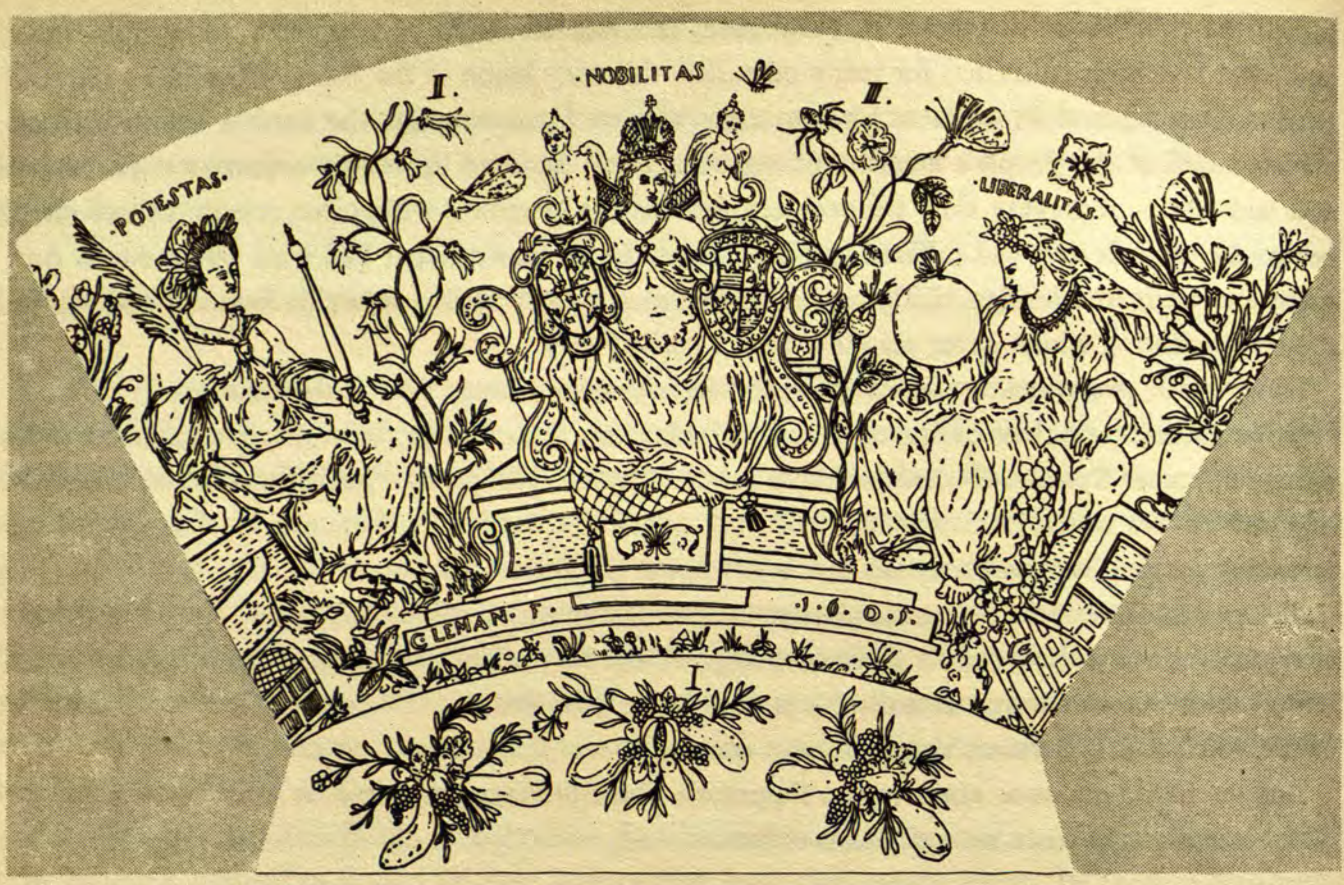
Kaspar Lehmann is considered the founder of the new era of glass-engraving and indirectly the father of the most famous epoch of Bohemian glass-making.

We know today that he was born in Ülzen in the Lüneburg Heath, on the left bank of the lower reaches of the Elbe. The founder of German philosophy, Leibniz, who lived a whole century later, stated that in that district the current language was Slavonic. Around the middle of the sixteenth century the Habsburgs united the German Imperial Crown and the Crown of St. Wenceslas. Masters of all arts gathered in the Emperor's residence in the Prague Hradčany Castle, coming from all lands: there were especially Dutchmen, Italians, Germans. Zikmund Winter corrected all contrary assertions when he described that a certain "Adam, the glass-cutter" worked in Prague as early as the year 1569. That means that in the sixteenth century the Bohemian glass had reached such purity and solidity that is was suitable for cutting. "And if the mention of this cutter does not satisfy critics, then a certain Shindler, a glass-cutter from the Turnov region, came to Prague in 1610. He certainly did not learn glass-cutting from Kaspar Lehmann but must have known his trade and it may be assumed that there were several such craftsmen around Turnov."

We could perhaps settle this dispute by saying that our people knew how to cut and polish the new Bohemian crystal-glass already some decades earlier, but that Lehmann was the first to use the hollow cut.

There is a substantial difference between grinding, cutting and engraving.

Glass is considered cut when the pictures stand out from the polished surface, whereas engraving goes into the depth. Lehmann was granted a concession for his method in 1609 " . . . because he had adapted his technique in some way to this new material . . ."



126. J. Koula: The Kaspar Lehmann engravings on the famous goblet found at Castle Hluboká, carried out after the copper-engraving designed by Sadeler. From "Archeological Relics", XV, 1892.

Lehmann made contact with the court of Rudolf II in 1588, when he received 15 gulden for some unspecified work. In 1590 he once again drew attention to himself and received 30 gulden "as an act of grace". Five years later, he was granted a coat-of-arms with the title "von Löwenwald". After 1602 he was a court employee as stone-cutter with a salary of 20 gulden monthly. That same year he became a citizen of the Malá Strana district (he did not live at the Castle) and after two years his income had risen to 30 gulden which, at that time, was an excellent pay for an artist.

His ambition, however, was the post of magistrate to the Counts of Tachov. Philipp Lang, that deceitful chamberlain to his apostolic majesty, seems to have promised him this career. For these promises the credulous Lehmann presented to him a cut glass with figure ornaments valued at 200 thalers, further a goblet and jug made of crystal. Just then Lang became suspicious that Lehmann had contact with certain courtiers who thought badly of him (Lang), and so he incited the Marshall of the King's Household against Lehmann who was deprived of his income and chased from the Court. For three years this famous engraver and his wife lived in direst need, part of the time outside Prague. Finally Lang fell into disfavour and Lehmann was rehabilitated to the Court. In 1608 he sued for the payment of damages of 1 000 gulden as well as the return of his presents. A year later, he was granted the concession and with his rank of nobility also the privilege of exemption from army billeting in his Prague household. Lehmann ceased to be Court Stone-Cutter at the death of Rudolf II, for in 1613 he signed himself as "former Imperial Court precious-stone and glass-cutter".

He was granted back payment of 200 gl., but demanded another 600 gl. which the deceased monarch owed him. In 1602 Lehmann bought a house for himself and for his wife, Reginalda, in the Malá Strana district of Prague. Within a short time he had quarrelled with his neighbours, Apolena de Ferrari and Tommaso Margarini di Pardi, the Imperial Lion Keeper. This disastrous house caused him to fall into debts which led him to ruin. In 1606 his wife died but, he, having hardly returned to work, took himself another wife, a certain Sabina. He grieved himself to death in 1622 when after endless court hearings he was evicted. His widow was left with a son who was still under age, called William Rudolf, to whom he left the sad inheritance of continuing the quarrels with his creditors.

J. Koula found the one preserved glass goblet in the South Bohemian castle Hluboká. Its magnificent ornamentations, based on a copper engraving by Sadeler, bear Lehmann's dated signature. In the History of Art Museum in Vienna — which has the greatest and best collection of crystal glass — Koula in 1892 discovered a small jug made of rock-crystal which he ascribed to Lehmann. He reported about it:

"The jug is covered with gilded silver stripes in which, just as on the metal handle, there are thickly-set rows of Bohemian garnets, set in square "chatons." The vaulted bottom of the vessel has fluting. The engraved ornaments betray by their arrangement that some form of metal mounting must have served the artist as a pattern. These traits characterize Lehmann who originally was a goldsmith. The figures of three Hermes — two female and one male — divide the surface of the vessel into as many fields. In the middle section fruit is suspended in shapes that were popular at the time among German goldsmiths. The most characteristic for us is the execution of the bunch of grapes which consists of a large number of globules. In Italy grapes were never cut in this fashion. But they can be found in identical execution at the bottom of Lehmann's goblet at Hluboká. Above the fruit there is a fly in one of the fields, on the other there is a May fly; in the lower corner the master engraved local fruit and flowers, among them a hairbell, which also appears in identical form and details on the Hluboká glass. Under the handle there is an interesting motif which more than anything else reveals the close relationship of the two glasses; i. e., a five-petalled rose with a cross-spider above it — both in minutest detail similar to the South Bohemian goblet decoration."

It is clear from the Dresden Archives that Lehmann lived for a short time in the capital of Saxony. In the "Green Vault" they exhibited engraved hollow glass from the year 1590 which is meant to prove that glass was engraved sooner in Dresden than in Prague. However, no author is mentioned anywhere. It is known that Lehmann left his birthplace as late as 1586. Since he made contact with the Rudolfinian Court in 1588 he must have reached the capital of Bohemia on foot within two years. The Saxon engraving is carried out after a pattern by Spanger which in idea points to Prague, where the artists of the whole world had been creating a specific Rudolfinian style. The technique of the Saxon work, however, is rougher and for this very reason should not be ascribed to Lehmann. The documents state only that Lehmann was Court Engraver to the Saxon Court in 1606 and that from 1608 until his death he settled again in Prague. It would be desirable to have a comprehensive study of the life of this artist . . .

In the "Burlington Magazine for Connoisseurs" E. W. Brown alleged that the so-called "London Engraved Sheets" were also the work of Kaspar Lehmann.

His engravings are best recognised by the very personal note in the depiction of the ground and trees as a coloured background and by the stones in deep intaglio which he depicts on the earth. Lehmann used this technique also for his work on rock-crystal chalices. Such a piece exists in Vienna and another, doubtlessly of Prague origin, in the collection of Pierpont Morgan, one of the most powerful of Wall Street magnates. The conjecture was once expressed that two Munich artists at the Court of Rudolf II, (Zacharias Peltzer and Georg Schwanhart, the Elder) gave Kaspar Lehmann the idea to try glass-engraving. This does not seem to be right, since already in 1614 a work about Kaspar Lehmann's technique of engraving was published in Leipzig under the title "Theatrum machinarum", i. e., during his lifetime. This shows most clearly what high estimation Lehmann's art enjoyed. He was more than just one of the Rudolfine stone-cutters, he was an extraordinary and at the same time tragic personality. He was probably not a very strong character, he can have been neither a pleasant nor a favourite companion but that may merely be a misinterpretation of the Dresden sources that inform us that he had to carry out his intentions at all costs. At the courts of the Electors he apparently asserted his will in such a manner that no one was sorry when he packed his bag and went on his way. But it might just as well be assumed today that the grapes were sour at the Court of Saxony and Lehmann had therefore the less reason to crawl before a German count, for none of the German courts could normally raise the means for the pomp of their masters, most of whom had more debts than money in their pockets.

The Rudolfinian Environment

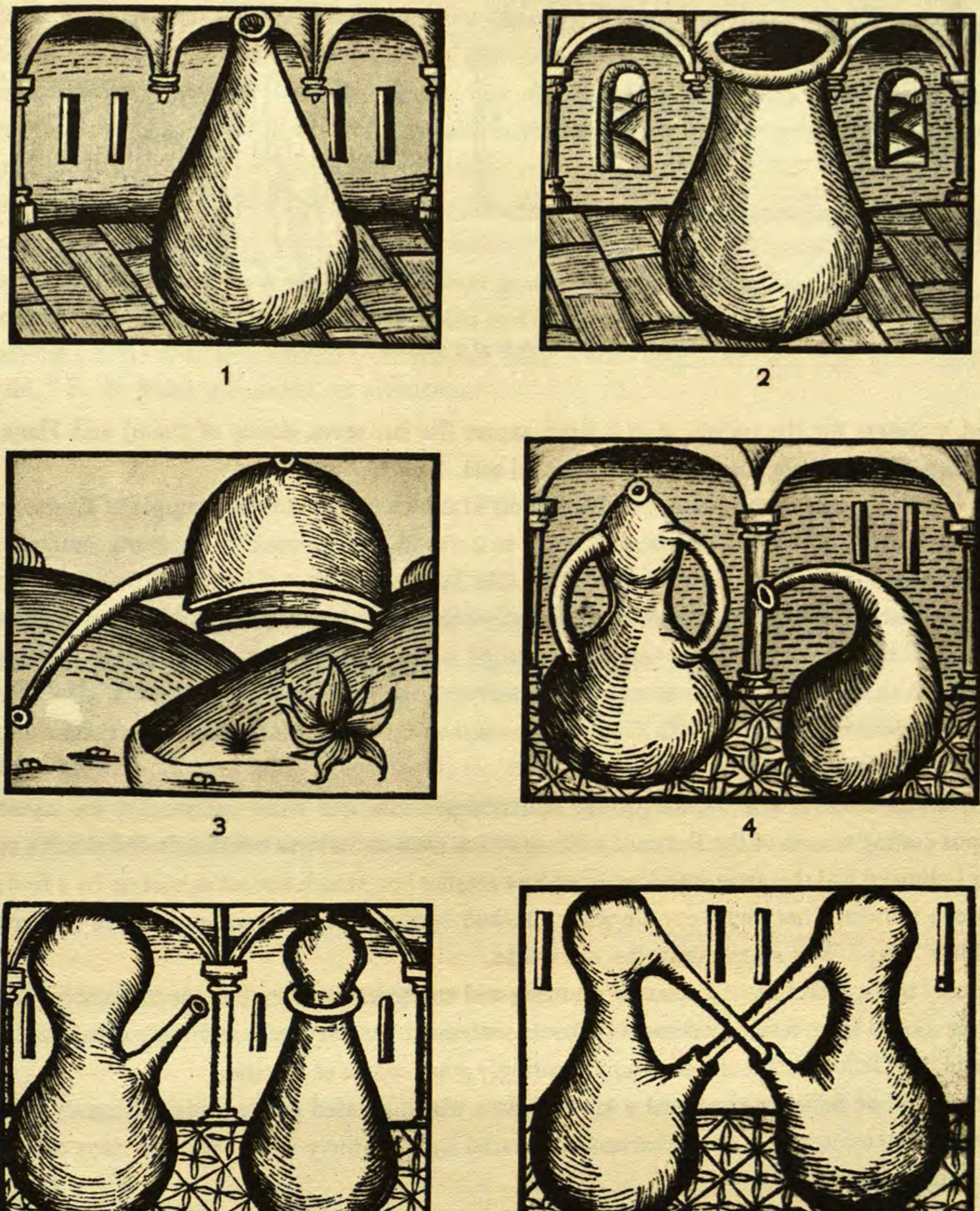
The Rudolfinian environment in which Lehmann's discovery apparently took place, was — one might say today — typically cosmopolitan. It had no connection with the creative abilities of the people. Only very few of the most famous masters of Rudolf II came from Bohemia, and, maybe for that very reason, only memories of their creations have been preserved . . .

Lehmann's activities left deeper marks. We have certain proofs that stone-cutters worked in Hradec Králové already at the time of Queen Elizabeth's widowhood; the St. Wenceslas Chapel as well as the Chapel in the Karlštejn Castle were decorated by Bohemian masters with polished and engraved stones; and many of the most beautiful pieces in the treasury of the St. Vitus Cathedral in Prague are definitely to be considered the creations of Bohemian skill. We know further that in the sixteenth century, before Rudolf came to the throne, six stone-cutters were working in Prague, the first of whom is registered in the year 1259.

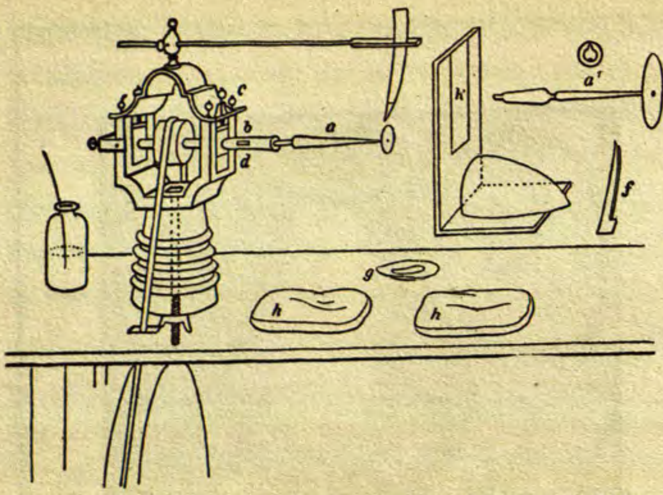
When Rudolf came to the throne their number rose to thirty-six. The explanation can be found in the fact that until Rudolf's time the goldsmiths themselves polished the stones. Rudolf, on the other hand, had stones collected all over Bohemia and everybody who was willing to look for them, in the Bohemian, Iser and Giant Mountains, was granted the concession to do so. Under the rule of this aesthete the goldsmiths specialised on work with gold and jewels and the Bohemian garnets became world-famous.

In Z. Winter's opinion, we have to distinguish several specialists among the stone-cutters. The common nomenclature applied also to the branch of rock-crystal workers. The working of stones for mosaics was left to the "flat-stone cutters"; the "emblem cutters" were occupied exclusively with the production of seals; they were also distinguished according to the different kinds of stones, diamond-, garnet-, ruby- or crystal-cutters. Garnets were cut and polished in North Bohemia (Rovensko and Turnov) already in the fifteenth century. When they won Rudolf's interest the Nuremberg goldsmiths took up these semi-precious stones and increased their popularity. Among the Rudolfinian stone-cutters there were three Czechs, two Dutchmen, seven Italians and thirty Germans. The pay of these people might interest us:

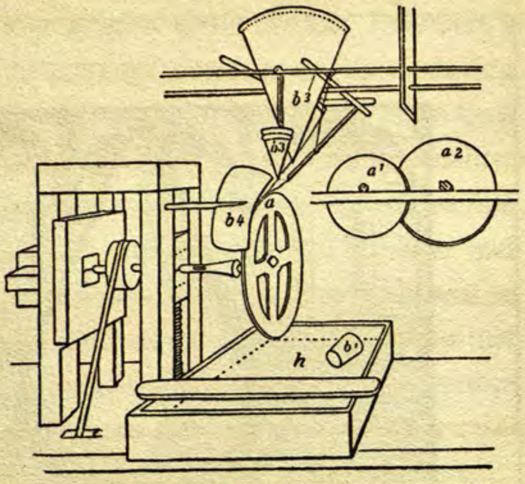
Ambrosio Miseroni was given only ten gl. monthly in the year 1598; Alessandro Miseroni in 1605 received already 12 gl.; in 1588 Ottavio had full 15 gl. and Giovanni Castruzzi in 1610 received 20 gl. They were given special payment for accomplished work. The Neustadt master Hans Maier in 1571



127. Alchemists' distillation bottles. Woodcuts from the work by Hieronymus of Brunswick: "Liber de arte distillandi de simplicibus". Published in Strassburg in 1500. — 1. Belly-shaped pot. 2. Urine pot. 3. "Helmet". 4. "Pelican" circulatorum and retort. 5. Two pots for the circulation of liquids. 6. Double "circulation" pots.



128. Scheme of an engraver's table.



129. Scheme of a polisher's grindstone. Reproduced from Czihak.

received 5 thalers for the polishing of a large garnet (he cut seven dozen of them) and Hans Götz in 1549 earned 118 gl. for the cutting of the royal seal.

That it was possible to earn money under Rudolf II can be seen from the example of Castruzzi who in 1605 earned 100 gl., three years later as much as 2 270 gl. for his work — a gigantic amount at the time for which he managed to buy a house in the Old Town.

It is asserted — and probably with good reason — that Rudolf preferred rock-crystal to glass; but apart from the Emperor there was another strata of society which had no choice and was gladly satisfied with the noble substitute of excellent quality.

The most essential of Lehmann's invention was not so much the path-breaking artistic thought as the perfection of the engraving table.

On the above-mentioned Škréta picture which represents the Miseroni family, we admire the enormous cutting wheels of the Bubeneč mills on which rock-crystal was worked. In Friedrich's opinion Kaspar Lehmann had this great wheel replaced by a smaller one, which was set in motion by a foot pedal, similar to a spindle. That would explain what followed — much later, of course, — for in the meantime the Thirty Years' War swept away the old world.

The easy transportability of Lehmann's cutting and engraving workshop made it possible for refineries to be moved from forest settlement to forest settlement. As they were relatively cheap, the anonymous and poor folk artists found here an increasingly good source of income.

For a long time Bohemia produced a kind of glass which pleased the very high demands of foreign masters; but all information about this was obliterated by the Thirty Years' War. In 1675 the Catholic priest Balbín wrote:

"Workshops of a very special type of glass-making are so numerous in the Bohemian forests that the country vastly excels all lands far and near. I know of twenty new establishments in the last few years and daily new ones are being set up. In a word, there is no district in Bohemia, even along the river Vltava, where there are no glass-houses . . . In many of them transparent, sparkling, pure and finely elongated glass is produced, which is sold for much money to the whole of Germany. In Nové Zámky the Counts of Kounic have established a new glass-house for especially precious glass, which is comparable to crystal in transparency and sparkle. On all noble and lordly tables such glasses can be found today."

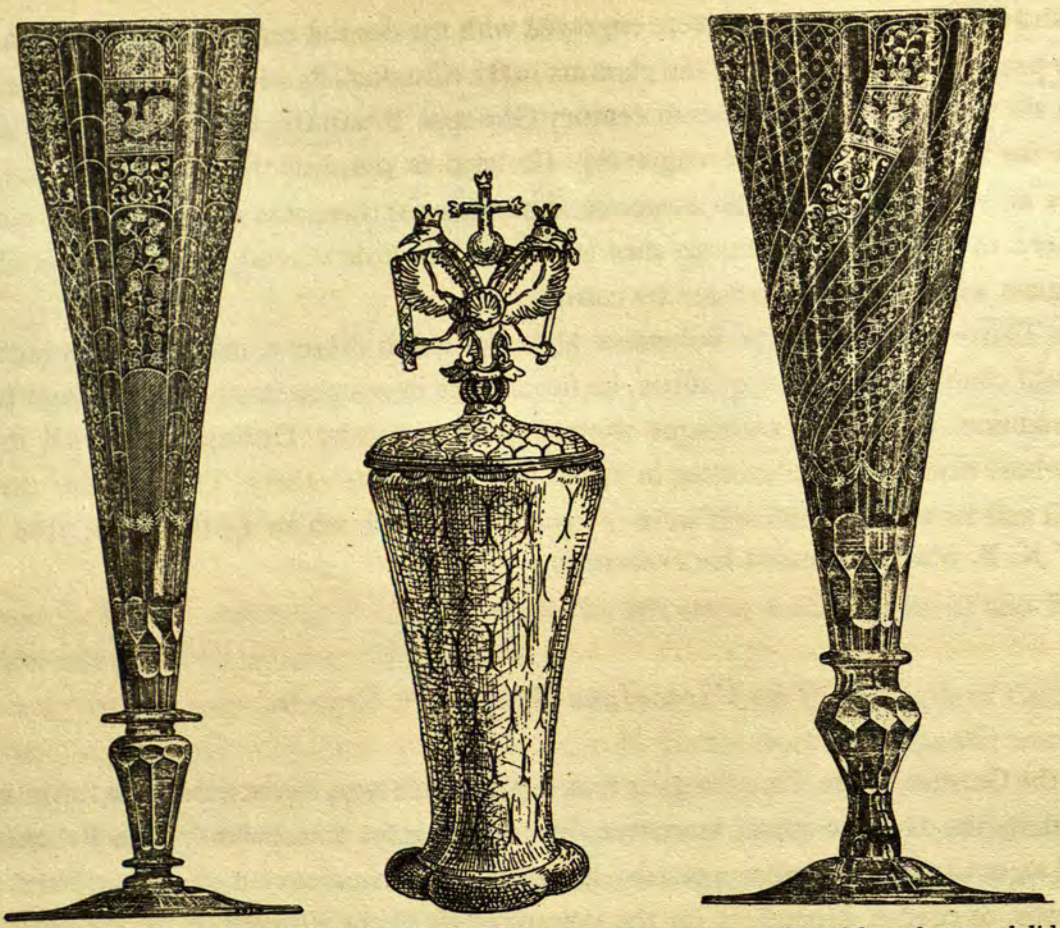
K. B. Mádl said about this phase of development:

"For their great skill the masters were entrusted even with foreign glass. In all inventories we read of French and English glasses which were engraved with the desired ornaments in Bohemia; and there is no better proof of the high level of the glass art in the Kingdom, its advantages and demand than the fact that in the twenties of the eighteenth century Giuseppe Briatti from Venice worked in a Bohemian glass-house for three years to learn engraving. He tried to transmit this desirable technique to the glass-houses at Murano, but with little success. The material there was not suitable for cutting. And also elsewhere, in Silesia and in Prussia they tried with but little success to gain a material similar to Bohemian glass which they ornamented by cutting.

After the Thirty Years' War the Bohemian glass, for a full century, maintained its high level. Its material could claim the very best qualities, its forms were developed in all directions and had already become a tradition; the cutting technique showed great virtuosity. During this period those pieces originated whose ornamentation excelled in motifs and in extreme variety. The excellent quality of the raw material and its artistic treatment were the two devices with which the Bohemian glass conquered the world," K. B. Mádl concluded his evaluation.

The Victorious Bohemian Crystal

Whereas the German or the Venetian glass was, in a negative way, characteristic for the many bubbles contained in it (the German glass, moreover, by its less great transparency) the Bohemian crystal represented an entirely homogeneous matter. In regard to transparency it stood without a rival. The glass mass was, of course, dependent on the raw materials at the disposal of the various branches of production. But neither the German nor the Italian glass could measure itself in this respect with the Bohemian; while the one was featherweight, the other, even if it contained the identical raw materials as the Bohemian glass, never rivalled its weight. The thickness of the glass wall of the Bohemian products far outshone all that was produced at the time.



130. Two magnificently engraved and cut drinking vessels and a goblet with a decorated lid. Bohemia, 17th cent. Reproduced from Gerspach.

THE TWO HUNDRED YEAR RISE OF BOHEMIAN GLASS

THE ACME OF BOHEMIAN GLASS can be seen in three typical stages of development:

1. The Renaissance epoch (from about 1620) characterised by rich glass goblets with facet or prism cuts, precisely carried out after old, tried and tested patterns.

2. The Baroque and Rococo period (about 1680—1750) with ornaments, festoons, and all sorts of curved and bulbous forms. The time of the monograms, portraits, coat-of-arms and wedding-beakers. The figurative ornaments and the love scenes lost in precision of execution and expanded in breadth. The many-sided stems, the pointed or dome-shaped lids were intertwined in the Venetian manner with gilded or coloured threads, sometimes even with ruby or gold strips. That was the acme of Bohemian glass-making. The individual pieces were three times as great and heavy as before.

3. The Decadence (about 1750—1830). The Silesian Wars administered to our glass industry heavy, almost mortal blows. Frederick II deprived us of Silesia, forbade the export of the glass manufactured in that region, and even more strongly opposed the import of Bohemian glass. The aristocracy with their refined taste was suddenly pushed into the background; in its early period the rising bourgeoisie lacked any artistic sense; longed for glaring, even if not harmonious colours on porcelain that was still beyond the pockets of ordinary mortals. The East was our only market at that time and this (mostly Turkish) Orient dictated bright colours as well as new forms and ornaments which suited its requirements and feelings.

As compensation for the porcelain, which was not accessible to the general public, the glass industry introduced the bone and porcelain glass covered with glaring, clumsy painting. The technique of "cased" glasses was renewed. Even if this represented a decline in comparison with the clear glass of the Baroque period and the gold-inlaid double-walled glasses of the Rococo period, it was an otherwise healthy and lively reaction on the economic conditions and the changes in social classes. More close consideration will be given to this when we discuss the activities of Egermann. In the consuming ardour of the long war periods two classes were actively participating in glass-making. There was first the defeated and displaced class with whom the decaying feudal wealth was vanishing. Until that time for a whole millenium they had formed the main pillar of the regular customers of the glass industry; and the other partner was the victorious class who so far did not show any essential inner need for culture because they were only gathering the means for the new production methods and were only imitating the hobbies of the aristocracy; so far they still lacked any compelling attitude to this arsenal of culture which had remained foreign to their nature.

The general impoverishment of this epoch is evident and well-known. In Bohemia it was the bankruptcy of the year 1811 and the resulting rise in prices which for a long time determined the general cultural development. In France there were the Napoleonic Wars which weakened the over-populated country which had grown poor as the result of the fantastic luxuries of the feudal Rococo. Special mention will be made of England and its victorious rise; for that country, taking advantage of the long years of blockade of the Bohemian glass, occupied the deserted markets; apart from pressed glass they suddenly brought out for sale a glistening, hollow-cut, soft lead-glass whose appearance almost cost the Bohemian glass its life.

The problem of transport had to be solved as one of the pre-conditions of Bohemian glass-making; for that country lacked those advantages given to all other countries that had produced glass hitherto. Egypt had the harbour of Alexandria and the river Nile; the Roman glass-houses had Ostia, the Rhine, the Iberian harbours. The products of Syria, Constantinople and Venice reached their purchasers by sea. And Bohemia?

From the beginning of the seventeenth century to the middle of the following century we carried our glass in wicker-baskets on our backs or pushed it in wheel barrows from the Bohemian Forest to Paris and Amsterdam, from the Giant Mountains to Moscow, Constantinople or Cadiz, on paths which could in no ways be compared with the roads built at the time of Maria Theresa. Today we can hardly imagine what insuperable difficulties our world-famous glass-makers had to overcome. The historians and copper-engravers have recorded every detail about this period, only one thing is lacking: how the working men of that time lived. What a theme — on a wheel barrow, carefully packed in barley straw, the glass-maker transported his set of magnificent glasses, ornamented by Renaissance engravers and cutters, from the source of the Elbe to Constantinople . . .

We can label this epoch the period of the travelling trade. A change took place only during the second half of the eighteenth century: the glass — packed in straw — was now transported on carts and with this hitherto unheard-of development the hitherto unknown occupation of the glass traders arose who were no longer tenants or owners of the glass-houses, nor active cutters, engravers, painters or gilders of glass.

Roughly about 1730 these individuals began to form into trade companies. These well-known Bohemian Glass Companies set up branches in foreign countries which were very far distant at that time; e. g. in the Spanish export harbour of Cadiz for trade with the Americas; in London, Moscow, Constantinople, Amsterdam, Paris and many other important trade centres where they ran a kind of exhibition which they called "Bohemian Houses". The epoch of the peak glass-making activities, these "Houses" and the expansion of the national industry exactly coincide with the Baroque period.

The chronicler among Czech writers, Alois Jirásek, described this as the age of "darkness" for the Czech people. Yet it was during this period that the Bohemian glass triumphed even over Venice.

But all these divisions are but a dry scheme which mechanically divides the living currents of development. In this evolution victories alternate with defeats and the creative powers of individuals and whole collectives complete each other in emulation or defeat each other in battles.

Peaks and Crises

Documents preserved from those days give us but a dim picture of the life of the glass-makers. Balbín said in 1675 that glass production had reached a dead point. After the stormy development of the years 1710—1720 this happy activity suffered another sudden paralysis: wars, trade prohibitions, the hypertrophy of the glass-houses and the resulting over-production had their influence on the development from within and without. The worst damage to Bohemian glass production was caused by the Silesian wars. After the Peace of Hubertusburg, production rose once again and with it trade, but already in 1773 Portugal raised its tariffs to such an extent that it completely paralysed the export via these important harbours. In 1790 the war once again put a brake on the glass trade. The French deprived the Bohemian glass-traders in Italy of their income, so that Russia suddenly became the main market towards which the entire production was directed; this involved a lowering of prices in competition. When peace returned to Europe once again, it became clear that only few had stood up to the difficulties, and those who had remained could no longer continue the foreign exhibitions. For the English and the Dutch had not watched this pause in Bohemian competition inactively; they had built their furnaces for hard coal and began now to exploit their exclusive position in the world market with their excellent and cheap wares.

Bohemian traders were forced to wait for incoming orders and we, therefore, speak of this as a time of "passive trade". To counter this attack, the small glass-houses in the forests with their low productivity were turned into extensive workshops which Schebek labelled "large-scale manufactures".

In the years 1804—1830 the glass industry was shaken by a second and far worse crisis and recovered only as a result of the inventions of F. Egermann. In 1803 sixty-six glass-houses were active in Bohemia producing raw glass to a value of two million gulden. Refining and trade made a profit of six million gulden. In 1839 ninety-nine glass-houses produced 10 0000 cwt. of ware to a value of ten million gulden.

131. Smoothly polished and decorated barrel of crystal glass, which was formerly very popular. Reproduced from the work by Czihak.

Apprentices

Refining, embellishment and cutting of glass employed many people, about whose worries and toil we read but rarely in the documents. The workers together with the glass-traders complained in 1766 of a certain Riedl who had treated them detrimental to the foreigners by producing two kinds of glasses: the better and more durable kind for foreigners which he sold to them at the price of one gulden cheaper for a thousand pieces and with free additional pieces into the bargain; the worse and more breakable glass went to the local customers. His main aim had been to attract foreign buyers because he was of the opinion that the local people were forced to buy from him in any case and they often went bankrupt. Riedl had got into the bad books of Count Desfours who refused to renew his tenancy in 1775. This same feudal lord published in 1775 a special guild rule for glass-grinders of whom there were many on his estate at Smržovka.

No married man under 24 years of age or a minor was allowed to keep an apprentice, and no master was permitted more than one. Without the permission of the master the apprentices were not allowed to visit the public houses, to prevent their "running about courting." Anyone wishing to enter apprenticeship had to produce a certificate of conduct and two guarantors. His period of probation lasted four weeks with the mutual right of withdrawal. The time of apprenticeship lasted two years. "If the apprentice serves his apprenticeship diligently and thoroughly, he is to receive a certificate of apprenticeship at the competent local magistrate in the presence of the master, whereby he is to present the church with half a pound of wax and to treat the assessors to a barrel of beer. Sons of masters pay half the amount. The one among the masters who fails to pay heed to this order will not be permitted in future to instruct his own or, even less, strange children in his trade; after his death his workshop shall be confiscated." (Mareš I, 41.)

Another feudal lord, who already concerned himself with glass production in the capitalist sense, was Count Wenceslas Norbert Octavian Kinský who in 1767 built a great mirror-glass combine in Sloup near Bor (near the Hermit's Stone), in Lindava and Velenice. To the North he developed a hamlet with six houses into a great centre. Nový Bor became a complete glass town which later was to reach the same significance for the international glass trade as, 150 years later, in the First Czechoslovak Republic, Zlín for the export of shoes.

On August 29th, 1699, Count Kinský published the following order for glass-painters and cutters in the market town of Chřibská:

"The apprentice, if not the son of a master, is to train for four years and must pay one thaler into the treasury; moreover, two guarantors must sign for him with a security of 15 kopas each that he will not run away or otherwise infringe the rules. After his apprenticeship the journeyman shall spend one year abroad or continue his work for the master. Who wishes to become master shall produce his birth certificate and his certificate of apprenticeship, shall elaborate some masterpiece in one and a half days, such as, e. g., the German Eagle in its full setting; then in the presence of the masters, he shall design the seven Free Arts and draw them free-handed on a paper, pay 15 kopas, consecrate four pounds of wax and treat the masters to a dinner and a barrel of beer."

In 1694 an order was issued for glass cutters, painters and jug-makers in Kamenický Šenov which foresaw four years of apprenticeship and two years as journeyman, the masterpiece being the design and execution of a successful figure of his own invention. Exemption from serfdom cost four gulden annually. The children of masters were exempt from all services to the feudal lord for the cost of three gulden. The Falknov edict for gilders and painters in 1776 prescribed four years of apprenticeship and six years as journeyman. The travel period of the journeymen was no longer mentioned. The same Kinský ordered that same year that no glass-cutter or grinder who was single, and especially no woman, should take on several jobs, but should keep to one only . . .

An Old Mirror Factory

Many instructive details about the conditions in Kinský's mirror factory in Sloup have been preserved. The necessary glass was supplied by the glass-house in Prášily which in 1763 Kinský rented to the Wiedersberg glass-house master Fabian Àbele (apparently a Swabian) on a ten years' lease for 1 000 gl. annually. The tenant pledged himself to give his entire production to the Sloup glass-house at an agreed price and a high standard of quality. Kinský, on the other hand, pledged to erect living quarters for the master and his assistants. Misusing his position as a representative of the Trade Commission, Kinský in 1763 forbade the glass-traders to sell Nuremberg mirrors; Abele, too, was forbidden to export glass to Nuremberg. The contract was renewed in 1772. Its new version was based on the past experiences:

Abele promised the Sloup factory the entire glass produced in both his glass-houses at a fixed price in good and suitable quality, the necessary strength and colour and according to a "Brabant" measure. This measure was to be two inches larger than the official size for mirrors because roughly that amount was lost in grinding. The price referred to square inches. Glass which showed an inferior quality in polishing was set aside and the wasted labour on grinding was placed at the discount of the glass-house master. Even good glass, lacking the prescribed measurements after deduction, was returned to the tenant without compensation. French plate-glass was sold in bundles of sixteen plates, 10×14 in., or ten plates 12×18 in., or one plate 24.5×32 in.; a plate 30×36 in. was calculated as one and a half, one 20×25.5 in. as two whole bundles. A bundle at that time cost 18 livres.* There was trade both with French and Bohemian glass, of which the first existed in smaller dimensions (14—15 in. wide and 18—19 in. long) and the Bohemian in larger dimensions. As it was not absolutely flat the picture was distorted. Therefore for framing pictures preference was given to a specially polished mirror-glass, although it was more expensive and yellowish. Only later, the chemistry of glass produced more perfect glasses. (J. Bradáč-Nežárecký.)

Abele was to "supply a piece of green, Jew, mirror-glass, carriage-free, to Sloup at eight kreutzers. The reduction of mirror-glass was to take place in accordance with the Nuremberg customs. Twenty percent of each delivery were retained for this purpose." A six-pot furnace produced 3 400 such "Jew mirror plates" a week. The production amounted to 157 gl. 12 kr., which amounted to an annual profit of 3 500 gl. In 1777 the wages of a glass-cutter, cover-maker and a beveller reached 30 kr. daily, apart from 10 kr. travel money. The journeymen, working in a mirror factory, strangely enough, were called "manufacturers". Further texts reveal that in the old mirror factories the same materials were used as today: emery, gypsum, clay and sponges.

Apart from white there were also green mirrors at the time. Letters from the time reveal that people demanded equally the thin, white mirror-glass as the green. But by 1772 the glass-houses had become passive, and the Duke, in 1780, lost all interest in them. Since that time there has been constant depression in this branch.

Documents from 1700 show what "two small German furnaces" of a mirror-glass factory consumed. The tenant annually received 3 700 cord** of soft wood and 300 cord of hard timber; for this he paid 600 gl. In the Zdíkov Woods one glass-house consumed 7 000 cord of wood annually for two furnaces, of which one produced mirrors and the other plate-glass, called abroad "flame glass". This is but a brief glance into an eighteenth century glass-house. But let us return to older times.

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* French currency (translator's note)

** 1 cord = 124 cubic ft (transl. note).

The Thirty Years' War had depopulated the country; many glass-houses had simply disappeared; many glass-makers had lost their lives; the entire trade had ceased. As a consequence, the glass-makers were heavily in debt till 1652, being unable to pay even the 1.10 gl. house tax and the 8 gl. forest tax for their glass-houses which remained hidden deep in the forests. After 1650 a change gradually came about; the scars of war slowly began to heal. The demand for glass rose to such an extent that the glass-houses were unable to satisfy it, and the owners not only paid their debts but even became rich. The rent rose to 9—54 gl., for mirror-glass to 30 gl. and for glass for rosary beads to 12 gl. Gube's report about the classical Bohemian glass-houses in the Vimperk area runs:

"Lying in the almost limitless forests these glass-houses did no little harm to the rulers by constant felling of trees and turning forests into meadow and pasture land; they built their houses and workshops at will, took in loafers and declared these as well as themselves 'freemen', no longer dependent on the feudal manors; they raised contributions and taxes from this rabble. The assistant glass-makers, sheet-glass makers, producers of rosary beads, stokers and pounders were free; when they came to some glass-house they worked there for a time and continued on their journey without worrying about the owners of the manor." (Mareš I. 66—67.)

The "Flux-Burners"

The "flux-burners", whose important task it was to prepare the natural potash, were not always direct employees of the glass-houses, but sold the flux to whom it pleased them. They either bought the necessary potash for their work or had it burnt by the "ash-burners" in the manor forests.

As a side remark it should be said that 1 000 lbs. of wood had to be burnt to gain one lb. of potash. Preference was given to beech wood, but twigs or tree trunks were also used. How expensive such undertaking would be today!

This anarchy was stopped by edict in the year 1714. Each glass-house master was assigned a certain number of "flux burners" who had strict prescriptions as to where to take the timber for their cauldrons and where to burn the ash. Herewith the rank of the privileged "flux-burners" was founded and the order was given that the glass-house owners and "flux burners" were not allowed to pay bondsmen more than 3 kr. for a "quarter" of the ash, and that the "flux-burners" were to sell the hundredweight of potash with an addition of three pounds at 4 gl. 30 kr.

The Early Capitalists and Their Proletariat

Johann Anton Landgraf, a former glass-maker, wrote to Count Adam Franz Schwarzenberg concerning the lease of a new glass-house belonging to the Count:

"The glass-masters of the Vimperk estate reveal clearly what great lords they are; for they behave as if they were gentlemen; in money, hospitality and clothing they are not equalled by anyone. From where does all this originate? Why, from the great forests and estates. The forests and the glass-houses bring them great profits; on the remaining land they keep cattle, servants and day labourers in plenty; from these they extract high dues and use them for their work; in short, they increase their income. These people have to buy all their foodstuffs from them and pay for it almost double the price."

But this boom at the close of the seventeenth century and the beginning of the eighteenth century came to a sudden end as the result of the rapid increase of glass-houses in other places. The price of the rosary beads, which had been 1 gl. 45 kr. per thousand, now dropped to 9 kr. and no-one was interested in buying them, even at that price. Large-scale production which might have pushed off this crisis was still unknown at the time. Since there was no sale, the glass-houses producing rosary beads worked only for three months in 1718.

The Discovery of "Chalk-Glass"

The so-called "Janoušek Glass-house" near Vimperk was especially famous, although at its beginning it was a poor glass-house leading a hand-to-mouth existence. Only when the master of St. Anton, Michael Müller, bought the place for 450 Meissner kopas, a change set in. But not immediately, for in the year 1685 he asked the authorities for release from bondage which applied to the entire glass-house.

He stated that under those circumstances no-one wished to settle here. The glass-house lay deep in the forest, off the beaten track, at the edge of the country; on the other side of the frontier there was much competition. There was no quartz here so that it had to be imported from another estate. Also forests suited for the "ash burners" could be found only at a great distance. The ground was infertile and cold; only oats and rye grew here but even that usually caught the frost. Wood had to be brought a long way by ox carts (only mature beech and pine wood could be used).

Müller was successful in his plea. Objectively there were not the smallest pre-conditions for the great success which he gained. "In the year 1683 Müller, by sparing neither diligence nor cost, invented a magnificent white glass, the so-called "Chalk-Glass".

Since in his own words he used for the production of this refined crystal-glass only good quartz and potash and no wood ash and since the glass was cut and polished, there can be no doubt that Müller's chalk-glass was a form of crystal-glass. But it was not the ordinary common glass which bore this name until the end of the nineteenth century. It seems that today no-one knows the production of Müller's original chalk-glass.

Captain Gube wrote in November 1693:

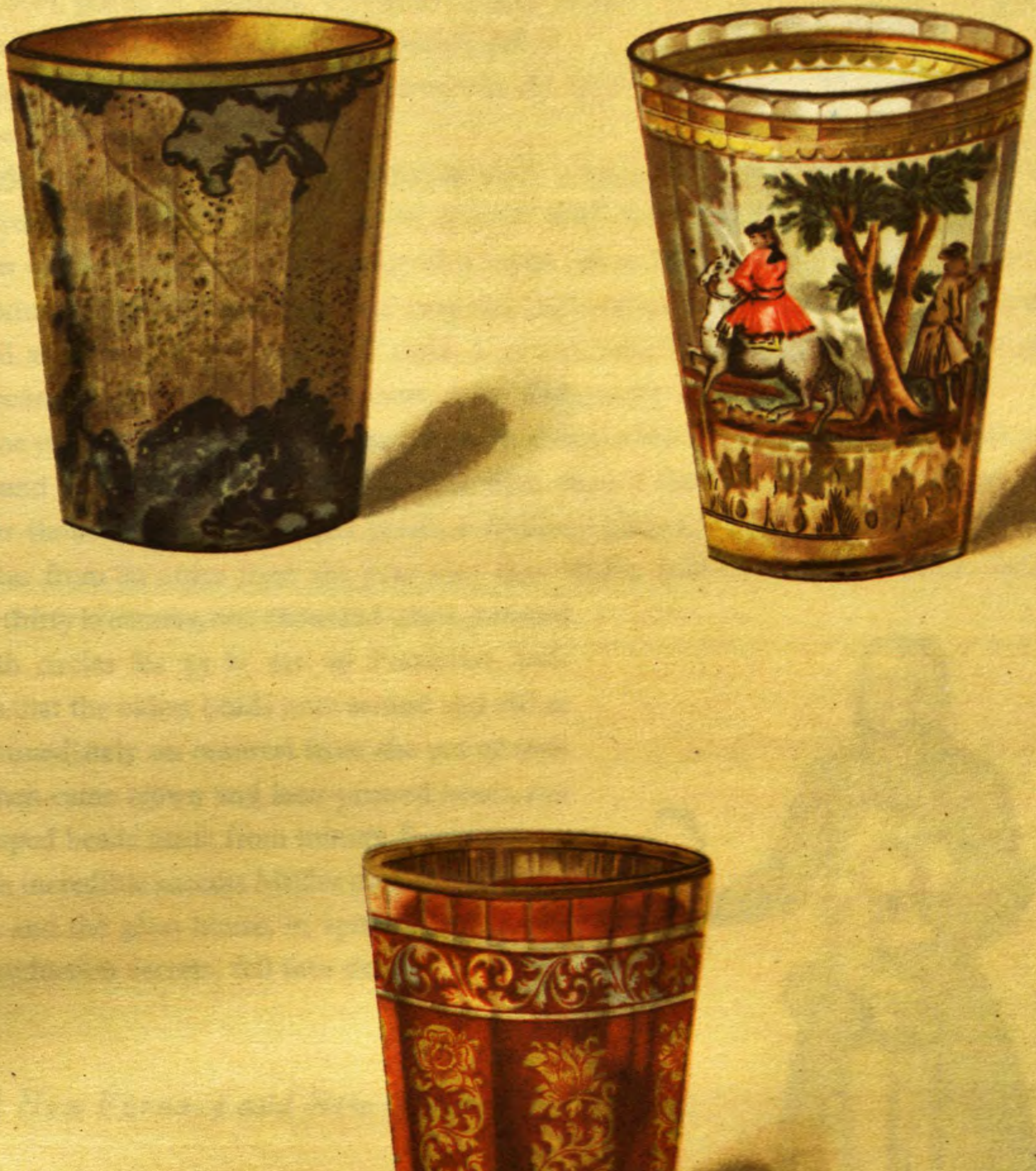
"Müller made several kinds of glasses, also large and small plates which in value almost equal the Buquoy glasses; but he kept his production process a secret and refused to reveal it to anyone to prevent the neighbours from producing the same. Some glasses were sent to Vienna but most of them to Moscow and Italy; the sheet-glass went to Strassburg and Frankfurt. He did not produce any bull's eye panes, because the other products brought more profit."

Braun wrote: "In 1688, when the glass-house master at Helmbach was granted the concession, this was the first glass-house in the Kingdom of Bohemia because Michael Müller was the first to introduce and produce the 'ruby' and chalk-glass."

It was a sort of copper ruby, previously known as "gold-ruby". Dr. Wolf is of the opinion it had been invented in Bohemia. But the French church windows and Oriental luxury vases would admit a re-invention at the most.

Anna Klara Müller wrote in 1772:

"When my father-in-law Müller came to the glass-house he expanded it so extensively that with his beautiful crystal and chalk-glass he attracted buyers from Spain, Italy, Holland, especially Amsterdam, and other far countries. He had invented the glass himself and apart from him, no-one in Europe knew how to produce it."



COLOUR PLATE XXXII

The same Müller was not only an excellent producer, but also an excellent salesman of his products. He himself wrote in 1708:

"Fifteen years ago 30 kreutzers were paid for a bundle or three-score of sheet-glass, whereby the worker added per bundle of the smaller, two, and of the larger, one pane for the master. That was called the "larger three-score". But now the ordinary "three-score" is used, for which I pay 24 kr. and so that they may do better work, 25 kr. The buyer, if he is a good client, receives 2—4, if a particularly good one 6—8 pieces in addition. The glass-makers receives 30 kr. for each glass, but per month one hundred are detracted which is called "weekly glass".

Let us compare this report with the memoirs of the glass-house master Rückl who died at a great age just before the second World War:

"The glass-maker's wages were counted in such a way that he was paid by the old tradition of 'three-scores'. This 'three-score', however, was not sixty pieces but a number of glass products whose production required the time and labour of a norm called 'three-score'. It was agreed to in advance which products required more work and time and calculations; three, five or even ten pieces were then considered as a 'three-score'. And vice versa, a greater number of those products were counted into a "three-score" which could be made more easily and quickly."

For some years the glass-house master raised the compensation for possible breakages to one hundred per·thousand pieces. "If I wish to keep pace with them I shall also have to chalk up one hundred glasses per thousand. I do no longer produce ordinary glasses," Müller concluded his report.

It is clear from an order from the year 1701 that Müller sold one thousand yellow, pressed, rosary beads for thirty kreutzers, one thousand white, pressed beads with circles for 33 kr. etc. to Frankfurt. Světecký says that the oldest beads were wound and either worked immediately on removal from the pot or over a lamp; then came blown and later pressed beads and finally shaped beads made from minute fragments.

After an incredible success Müller died in his seventieth year and the glass-house, in spite of large numbers of production secrets, fell into decay.

A New Furnace and New Glass

Chalk glass did not, after all, remain the exclusive property of this glass-house. In the Krumlov region glass-house master Stegbauer, seeing no other way out of his distress, tried new mixtures until, after 1687, he succeeded in producing chalk-glass for which he then began to reserve two pots. But he tried also something else:

"By building a complex furnace, which he invented himself, that in a fortnight burnt only the amount of wood it had previously consumed in eight days, he began to produce another sort of

132. Wine-merchant with drinking vessels from the 18th cent. Copper-engraving by M. Engelbrecht and M. Rössler.

glass . . ." The new Stegbauer furnace was much smaller than the former one which held four pots. He also dispensed with the old wood drying-chambers which had consumed a great many logs and built a new one, by the side of the furnace. Thereby he saved large quantities of timber. He further ascertained that for chalk glass it was not necessary to use ash which was such an important ingredient in the production of mirrors and rosary beads. The rise in output was characterised by the increase in the consumption of beer: in 1699, 51 barrels of beer were emptied, a considerable quantity in comparison with other glass-houses. In 1711 this same glass-house produced "crystallin" which they supplied to Venice.

Elsewhere we discover that the ash for the production of the flux could only be burnt from mature trees that had been broken by the storm, never from lying or even rotting timber and that it was impossible to produce sheets of chalk glass. For windows the most durable were green or greenish bull's eye panes, although there was no glass which by age, sweating or steam did not become blind.

In 1767 there is already talk of several sorts of glass: "of white solin, of lead mirror and of optical glass."

Stegbauer himself wrote that he was the only one in Bohemia who produced lead mirror-glass.

Productivity

The productivity of old the glass-houses was remarkable. According to a contract, Nicholas Preyssler in Horní Planá supplied 6 000 transparent, 15 000 common window panes, 120 wine and 60 beer glasses. Such a glass-house was burnt down in 1670; for reconstruction the owner received from the authorities 14 000 roof tiles, 140 laths and 1 000 bricks. It was, of course, a timber construction. In 1697 Ferdinand Hauer began to melt chalk-glass in the Planá glass-house. In what way he learnt the secret from Müller we do not know.

Here is the monthly account of this glass-house for June 1694:

They produced 14 180 pieces of different hollow glass to the value of 141.40 gl. (the workers received 30 kr. per dozen;) 5 000 transparent bull's eye panes (the better sort) at 50 gl.; (the worker received 15 kr. per hundred); ordinary window panes six "chests" at the value of 30 gl. (whereby the assistant received 2 gl. per "chest") and 5 400 rosary beads at the value of 6 gl. 45 kr. (the worker earned here 3 kr. per hundred). So that in one month goods to the value of 228 gl. 25 kr. were produced. Four assistants were working on hollow glass, three on window panes and one on rosary beads. Eight years later, the annual turn-over amounted to 3 083 gl. After the year 1690 the glass-house at Dobrá Voda produced also 200—300 pieces of watch glasses.

Wages

When we trace the origin of chalk glass, we include also the Buquoy glass-house that lay near the Půhoř Lake on the Austrian border. There the assistants were paid partially in glass. That means that when producing white sheet- or hollow glass which was worth 70 kr. per "three-score" they received half the wages in kind. But when the master needed the goods he bought them from his assistants more cheaply than the glass-house prices. Exploitation is clearly seen in this. Because the expensive chalk glass did not require so much labour in production the assistants were paid less.

Beer

The Buquoy glass-house on Mill Hill seemed to have been very thirsty in 1757. Annually 120 barrels of beer and 720 pints of brandy flowed down the throats. Of course, it was a fairly large glass-house, buying annually 150 cwt. of potash (one measure of ash cost 10 kr.). Only when the glass-house under Seewald's management burnt down do we find out that there were also fifty brass and iron glass forms (1766). This is the only mention of the use of such implements for pressed glass.

The Greedy Gilder

Gilder Lechner had much work in 1786 when he received an order from a noble family amounting to over 460 gulden. When he was persuaded to take on some workers if he wished to complete the task he answered he wanted no strange helpers. He said they would only spoil his own men. He paid them 30 gl. annually, whereas in other glass-houses they were paid one gulden a day. They would only stay with him a short while and only until it suited them to continue on their way and become independent. They were all untidy people, all of whom had some of the artistic temperament. He would prefer to labour himself to finish his orders, if only God would preserve his eyesight, as he said.

Coal Fires

In 1767 attempts were made to heat the glass furnaces of the Hořovice glass-house with hard coal. No success was registered. Friedrich Egermann was present during the second attempt. He, too, as we find out later, had registered a failure with this in the Děčín region in 1804.

A Glass-House Master Must . . .

The following are the instructions of a feudal lord in 1715:

" . . . the master not only must live in the fear of God, stop all cursing and avoid all indecencies, but also demand the same of his assistants." The master had the right to engage journeymen because he was acquainted "with the total glass production". He had "to keep accounts" with his workers once a week according to how much glass they had delivered and how many victuals they had drawn. Badly shaped or useless glass was taken from them but was to be counted as scrap and they were not to be paid for it. When felling trees for fuel and as "ash wood" the master was to pay regard to the hunting and foresting interests, to keep the woods clean and cause no damage. The victuals for himself and for his workers were to be bought exclusively from the manor, at the most, he was allowed to buy bread elsewhere if baking had stopped.

The workers were to be paid for their work in money, not with glass, as was frequently the case. A hundredweight of breakages was accounted for as two gulden 15 kr.

He was to produce "common glass" window panes and all those sorts of glass which brought the greatest profit to the manor and for which there was the greatest demand.

He was not to occupy himself with sheet-glass or other glass that required "much material".

As reward he was to receive annually 52 gl., 14 measures of rye, 2 measures of wheat, and 16 kreutzers travel money. Moreover he was allowed to keep a cow which in the summer could graze on the manorial pastures and for which he received fodder during the winter months. The manorial cart was to bring him the wood. As living quarters he received a room with a chamber and a kitchen . . .

The Glass-House Farmsteads

Numerous documents about the purchase and leasing of glass-houses contain entries about the exact extent of the glass-house farms. No glass-house could exist without this nor the woodland pertaining to it, since these represented the material basis of life and production. In 1774 J. L. Riedl held thirty tracts of woodland on the estate of Count Clam-Gallas, between the two sources of the Kamenice river. Beside the glass-house, for which he paid 7.30 gl. rent, he sold beer and brandy and bought salt in Liberec. He was allowed to sell all these articles to his workers. Moreover, he had a mill and a saw-mill at his disposal, for which he paid an annual rent of 5 gl. 50 kr. For the meadow he paid 22.30 gl. and for two small houses 55 kr. That this was not bad business for Riedl is clear from the fact that at his own expense he had a parsonage, a cemetery and even a chapel erected and, on top of all this, made a profit of 2 500 gl. He had once been a clerk to a glass-house. His two sons took over their own glass-houses and so a new glass dynasty arose.

While this was developing, the Schürers, another, later glass-makers' family, sent their son on his journey in 1771 and again in 1776, saying:

"We could not give him anything; a measure of corn cost 14 gl. The times were terribly bad, there was no income, no master could afford to keep journeymen."

The measure referred to is an old hollow measure which equalled 93.6 litres. Altogether the prices and figures in these old records are very interesting. We have already spoken of the "chest" as a measure for bull's eye panes. One entry from the year 1675 states that such a "chest" contained 42 three-scores, (1720 pieces) of mirror-glass for 25 gl.

For the production of "crystal-glass making" someone ordered twenty pounds of borax and six pounds of tartar. There is also a mention of blue glass. The cobalt necessary for this, which did not exist in Bohemia, had to be imported from Schneeberg in Saxony and cost nine to twelve thalers per old hundredweight. There are also orders for the purchase of saltpetre.

A soap lye is supposed to have been excellent as an admixture to the ash. The finest clay for building furnaces came from the area of Benešov; that fact should be an encouragement for the porcelain industry today.

The most frequent of the old timber measures is the old Bohemian hunting designation "stallung" which equalled forty bushels or thirty-two square cords. The extent of the glass-house forests varied from two to four "stallung" i. e. between thirty-one to sixty-two hectares.

It is a mistake to assume that around 1700 the melting and refining of glass was carried on in close proximity to decrease the difficulties of carting (in the truest sense of the word) the glass products. The glass produced by the famous Müller near Vimperk in the Bohemian Forest was, for example, taken or carted for refining to the most extreme north of the country, to the region of Česká Lípa or Kamenice, mainly to Kamenický Šenov, Nový Bor, to Kittel near Polevsko etc. Of course we are dealing here with the transport of glass that was not obtainable in the neighbourhood, as, in this case, chalk-glass. Similarly, the glass from the Sázava region was taken to North Bohemia for refining.

In the middle of the eighteenth century a "Turkish Company" was founded, an export company about which much has been written. The Turks bought large quantities of glass in the Czech Lands, either directly or through trade centres beyond the frontiers.

A Bohemian Glass-House Abroad

It is interesting that not only Bohemian maltsters but also glass-makers were often enticed to other countries.

On page 130 Mareš describes the attempt of the Marquis Perlas di Rialpa to set up a Bohemian glass-house in Slavonic Brod (on the former Croatian frontier with Turkish Bosnia, now in Yugoslavia) A willing glass-house master pledged to go to Brod in 1728 with a builder, six glass-makers, two producers of sheet-glass and rosary beads as well as two apprentices. He promised to come out in one or two waggons, to set up a glass-house there, a stamp-mill, flux-burning and to build a chalk furnace. His further tasks were to be the testing of the submitted ingredient and raw materials there; should these prove satisfactory, he was to select from among his own people one suitable person as glass-house master. Then the master and his builders would be allowed to return to Bohemia "first having, however, taught their art conscientiously to the selected serfs."

The master was to bring from home four hundredweight of arsenic for about 32 gl., two hundredweight of manganese for 20 gl., one hundredweight of enamel for 10 gl. and half a hundredweight of cobalt for 15 gl. as well as other small items for glass colouring. They were also to supply the necessary brass and models. All this was paid for out of the Count's treasury. For these activities the Marquis promised the master 500 gl. and a daily pocket money of 2 gl. during the journey and during his sojourn. The builders were to receive 2 gl. daily; the four sheet-glass makers and glass-makers 1.30 gl daily; the rosary bead makers, the melter 1 gl. daily and the apprentices 30 kr. daily.

The waggon load from Vimperk to Krain was to cost 140 gl. which the Marquis promised to pay. From there, they were to proceed in the Count's carriages. As soon as they arrived they were to start firing the bricks and then building. During the period of construction the glass-makers would receive only half their wages, when full production was in progress, the plate-glass makers were to receive 30 kr. per "three-score" the glass-maker 24 kr. per hundred and the rosary-bead maker 6 kr. per thousand. The newly-named glass-house master was to receive a suitable emolument.

In fact, within three months the master had erected the glass-house at Brod and made successful tests. But after his departure the glass-house declined "because the Marquis did not wish to take on Bohemian ash-burners and used only local people who were not suited for the task."

Finally he had to send for a sufficient number of ash-burners to maintain the productivity of the glass-house. For the one who had been sent for could not keep the glass-house running. That is one of the documents which show clearly that "ash-burning" was a craft which demanded a considerable period of apprenticeship before it could be independently practiced.

C. F. KREYBICH

Although Michael Müller, the inventor of chalk-glass, was simultaneously a skilled exporter who sold his goods to Germany, Russia, Italy, Spain and Holland, the other glass-traders were usually exporters who specialized exclusively on the trade with glass. The most widely travelled of all the North Bohemian glass-traders was perhaps C. F. Kreybich who was born in 1662 in Kamenický Šenov.

He learnt glass-painting and cutting and engraving at Chřibská just like Egermann at a later stage.

Accompanying his brother-in-law, the glass-trader Christoph Pilz, he started his career by buying a wheelbarrow-load of poor glass at Preyssler's St. Anne glass-house. With this he wandered through Bavaria, Salzburg, Carinthia, returning home via Ljubljana and Graz to Vienna where he hired himself out as a labourer. But the war drove him away in 1683. Via Znojmo and Jihlava he reached the Rybná glass-house in North Moravia where he worked for one and a half years and then returned to Chřibská.

Having become master, he dragged his wheelbarrow, laden with glass, through Lusatia, Brandenburg, Pomerania, Stralsund, Riga, Reval, Narva and Dorpat. For his return journey he selected the way across Prussia. In 1685 he married and a year later we see him once more on the journey, this time across Poland to Riga and Reval. In Vilna he sold his entire load since he bought only the very best glass. Until that time he had always travelled with a wheelbarrow. But in 1688 he started his journey to Saxony, Hamburg and London with a waggon. For six weeks he did not sell a single piece since the English capital at that time had six glass-houses which produced better glass. But Kreybich's glass was painted and cut, and that was something seen here for the first time. Finally he sold everything and at a very good price.

The fifth journey took him through Lübeck, Denmark, Sweden, Litvia and Poland. Then he left for Moscow with two full waggons. When he returned he received an order for 20 000 gulden of glass-ware from his brother-in-law Palme who was in Spain at that time. This glass was to be sent via Hamburg. On this order Kreybich made a profit of 500 gl. in eight weeks. For seven times in succession he visited Hungary, Transylvania, Wallachia and Constantinople! In 1699, he went via Venice to Rome. He undertook eleven more long journeys to Constantinople, Transylvania etc. In 1721 he returned home.

"There were crowds everywhere at the time," Kreybich related, "not only among the cutters, but also the bead-makers and bevellers."

One year after his return home his house burnt down. His only son died in 1729. That was a heavy blow for the old man who died in 1736.

JOHANN KASPAR KITTEL

A glass-maker and trader of similar character was J. K. Kittel, who had the idea to entrust his glass to scissor-grinders who were travelling far and wide at the time. At the beginning he gave them a basket or a wheelbarrow-load of glass. Those who returned with the profit received a whole waggonload of glass. Since he did not possess so many articles as his daring fellow-countrymen were able to sell abroad, he had to buy them in increasing quantities. In this way the carriers of Bohemian glass came into existence. At that time they began to influence the market, and especially Kittel suited his glass to the customs and tastes of his distant customers; he took care to raise the quality of his ware, and saw to it that it became purer and whiter, had more perfect shapes and to achieve this he designed many of them personally.

Not only Müller, but also Kreybich and Kittel made their way into Murano secretly, under a false name, to see what they might learn there. Schebek says that Kittle, having come from Šumburk on the Smržovka estate, founded his glass-house on the Rumburk domain in 1580.

133. *Roving glass-seller from the 16th cent. Based on an old woodcut.*

CHRISTIAN FRANZ RAUTENSTRAUCH

C. F. Rautenstrauch helped Kittel in his immense success. He began as his youthful assistant, became co-partner in the company and finally also his son-in-law. He was born in 1677 and died in 1743. In 1710, for the first time, he took glass to St. Petersburg. He repeated the journey a number of times. In 1714 he visited Portugal and on this journey he gained great success.

During the Prussian Wars this travelling merchant was caught as a spy not far from his home; he was bound to the tail of his horse and dragged until he remained unconscious. He died as the results of this treatment on March 20th.

Apart from these, the most famous names of glass-house masters and traders, there are a number of others who like Rautenstrauch dared to travel to the most extreme West of Europe, to Spain, especially to Cadiz, the main export harbour of the time for exports to Latin America.

They exhibited their wares either in special shops on the San Juan de los Dios Square or they carried it in baskets from door to door. Their success incited others:

On October 10th, 1715, the glass-traders of the three most important North Bohemian estates decided no longer to sell anything to peddlars and to deliver their goods henceforth only to the rightful traders at a previously fixed price. That was the first cartell which the producers formed with the traders in Portugal in fear of lowering prices. By this move they dispensed with those who had helped them to found their famous business.

A further step in the development of this export was the exchange trade — the glass-ware was exchanged for products in foreign countries, bringing a double gain to the Bohemian glass-traders. In Spain and Portugal they exchanged glass for tobacco, in Holland and Great Britain for fine cloths and silks; in Moscow for leather and furs; i. e. articles for which there was an easy market in Bohemia. This trade brought them double profit. The business was all the more remarkable for the circumstance that the people who set it in motion and built it up were not townspeople, but very simple country folk whose basic character trait was one of truly legendary economy, rigid discipline and baroque piety. These traders soon became very rich and through them also the villages in which this commerce started.

For example, the village of Bor had been a small farm in 1700 which belonged to Count Petr Kořenovský. He divided it up among his serfs. The hamlet which was constructed as a consequence, beginning with a few timber houses, grew into quite a considerable market centre within the space of fifty years. Its unique position, climate and economic conditions joined to give this unknown village a great future. It became the economic centre of the entire North Bohemian glass production. Constantinople alone paid twelve to fifteen thousand ducats in cash; in Barcelona the Bor traders had at one point a bank deposit of 250 000 ducats. In Lisbon they alone had 75 000 gl. in the Austrian Embassy. Similar enormous sums lay also in England and Moscow, placing traders into a position to finance the Emperor when he was in straits.

The Glass Trade Companies

The glass trade which looks back on a long and changeful past had to fight against enormous obstacles and difficulties. There were the customs dues in Germany, which at that time was split up into small parts which barred the natural way for the glass export down the Elbe to Hamburg.

Austria, too, had no liking for this enormous stream of goods and barred its way by protective tariffs on re-export goods.

This foreign trade was not built up by individual enterprises (although it had developed out of these), but by whole collectives, the "companies". These were an essential necessity, for the death of a single trader might have severed the connections once they were opened, depriving hundreds of glass-makers and refiners at home of their daily bread.

By co-operation such a glass company gained, on the one side, greater means of production and larger capital, and, on the other side, there was less risk during crises and loss, because it could be divided among more participants and did not hit any one exposed individual. Without these glass companies the glass trade and the entire Bohemian glass production would never have risen to such heights.

For a long time the partners in these companies were not capitalists in our sense of the word; each not only brought his money but also his own labour power and that of his family. The profit was annually divided per capita, not by giving each one an equal share but according to the importance of this or that partner in the company, in which quarter, half and full members were known. In such a company the son of one member entered already in his earliest youth and when he proved his worth moved up the whole ladder from apprentice, servant, quarter, half to a full member and he might even become the head of such a company. The widow, after her husband's death, remained a full member for a long time.

This collective which absorbed all members of several numerous families had sufficient power to set up stores and shops in distant lands and to run them by themselves.

In this lay one of the great secrets of their success: even the business in foreign lands was run by people who had a personal interest in its prosperity.

But that alone was not the deciding factor. It was important for the young people to go abroad already at the age of fifteen into a completely strange environment where, as we can see, they were strictly supervised, had to learn foreign languages, and gained an immeasurable advantage by practical experience and knowledge, not only of the business itself, but also of the taste and requirements of a big international harbour. Frequently they would accompany the cargoes of goods even across the oceans to the colonies. In Spain and Portugal these companies set up the so-called "Bohemian Houses" in which one of the members ruled with full authority for a period of three years. The "servants" (as they called themselves) of whom there were sometimes as many as fifteen, stood in complete subordination to him.

The "Superior", who ran the house, was responsible for all his orders, and that solely to his headquarters at home.

Even among the "servants" there was a hierarchy. The oldest, the deputy of the "superior" was in charge of customs arrangements, kept the account books, gave orders after consultation with the "superior" and shared the supervision of the collective. The others were assigned — according to age — the various tasks of correspondents, shop-assistants, salesmen; the youngest had to carry out the rougher housework, go shopping, cook, clean and scrub the floors and keep the house in order, because no foreigners were employed — not even the cook or a servant. In these "Bohemian Houses" all was arranged in a way to resemble a strict monastic order.

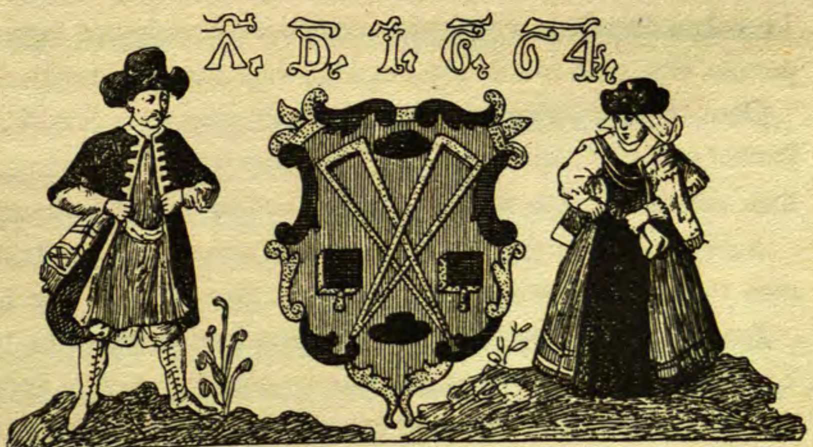
The work began in summer at seven, in winter at eight o'clock in the morning. At the sound of the bell each person had to be at his assigned place. At about two o'clock in the afternoon they gathered at the common midday meal, after which, in the Spanish custom, there was a short siesta. During this the enterprise was closed. The stores opened again in summer at half past two and in winter at three o'clock and continued until closing time at seven o'clock.

Now the "servants" had leave to retire to their rooms and read or write there, play or entertain each other at liberty. That was — recreation hour. Playing cards or dice was strictly forbidden.

The house sparkled with cleanliness and there was order as on a battleship. The whole week no one was allowed to go out, except on duty; i. e. the cashiers to collect foreign currency or bills; the first representative when he had work at the customs office; but all were controlled and the time for these outings was strictly limited. In the evenings no-one could think of going visiting. The gate was under double lock and the "superior" had the key to it.

On Sundays everything was closed; there was no work and after the communal breakfast all went in two's and three's to early morning mass at the church and later attended together the High Mass. Only then were they allowed to go alone "to breathe the fresh air" and they gathered again at lunch time. In the afternoon there would be a common excursion to the Corso but after Matins all had to be back at home again. And because there were always many music lovers in the House, they used to make music after the evening meal and sometimes even guests were invited. But at ten o'clock all entertainment ceased. The guests had to leave and all retired to bed. Even on Sundays there was a strict rule against entering an inn or coffee house.

In the early years the rosary was said daily before supper. On Saturday evening the "superior" read aloud from the New Testament and gave a short sermon. Every month they went to



134. Painting on a goblet of the hat-makers' guild in Cracow, 1664.

Confession and Communion. Relations with women were forbidden. Anyone who transgressed against this rule went on the first ship to Hamburg and from there home. Other offences were first reprimanded by the "superior", then by the Bohemian head office and finally the offender was dismissed and sent home.

They travelled from Bohemia to Spain on foot! Only older persons were granted permission to go by post coach. These "Bohemian Houses" were founded in Cadiz before 1738; soon there were others in Seville and Madrid. It seems that the company originated from Bor. Apart from Spain there were similar establishments in Amsterdam, Oporto, Petersburg, Constantinople and Smyrna (in Turkish Anatolia). Of course, there was competition among them. They were also founded in Reval (Tallin), Riga, Copenhagen, Lübeck, Hamburg, Bremen, Leyden, The Hague, Rotterdam, Bordeaux, San Sebastian, Bilbao, Santander, Vigo, Santiago, Malaga, Valencia, Marseilles, Livorno, Naples, Palermo, Ancona, Trieste etc., even in Mexico.

Today it is difficult to follow and compare the enormous profits of these feudal companies. The fact is that these traders built churches with their income, had the Piarist College in Bor erected, laid out cemeteries, made grants and had their own alms houses; i. e. they had means which only the highest nobility of the time had at their disposal.

But there was another side to the picture. These traders became now quite independent from the glass-makers and began to make their profits also from the glass-house masters and from production generally, forcing down the prices. Since usually it was impossible to produce first-class ware for the prices that were offered, the producers now made worse quality goods. And so disputes arose, in which the dirty washing was often washed in front of the Emperor, as Schebek writes on page 236.

It would lead us too far to follow some such disputes. The Austrian monarchy of the time was a purely agrarian state and since the glass production brought immense sums into the country the government in its own interests was forced to look after this branch.

Protection and Limitations

Just as in Venice (Murano) so also in Bohemia glass-making was considered a state secret and its betrayal abroad was strictly punished. In 1735 people in Silesia who could make artistic glass and cut crystal were strictly forbidden to go abroad to those places that were making efforts to attract them.

Maria Theresa had to remind the authorities in 1751 they should treat the glass-makers and refiners more indulgently. For many attractions were offered to them from abroad, especially from Sweden. Therefore already in 1750 strict regulations were issued forbidding them to leave their home and any persons who tried to hire glass-makers were threatened with draconian punishments.

Glass-makers' assistants and works-employees were forbidden to journey abroad and fluctuation was limited to such a degree that the glass-house masters were not allowed to give the departing journeymen their certificates into their hands, but had to deliver it directly into the hands of their new masters.

Anyone who revealed the emigration of a person received three ducats. Who tempted such a journeyman to go abroad was punished with a fine of up to one hundred ducats.

But the country fought not only against foreign countries, but also against the other Austrian lands. The district authorities instigated close inquiries when in 1767 the glass-maker Thomas Lenk entered a complaint "in the name of all other Bohemian glass-makers that:

1. the master glass-makers were mostly foreigners and that the money they earned flowed abroad;

2. although a mirror glass factory brought its glass-house master almost 8 000 gulden, they paid their journeymen less wages than before;

3. the glass-house masters paid their journeymen with bad, foreign currency so that they lost much during exchange;

4. during investigations only the masters, never the journeymen found a hearing;

5. the glass-house masters sold to their journeymen meat and other foodstuffs at a much higher price;

6. they were destroying the forests and taking wood out of the country." (Mareš, p. 142).

The great periods of crises which were caused by the long wars of the time constantly sharpened the contradictions between capital and labour. Finally the Seven Years' War demanded state intervention: the government issued

The Glass "Reglements"

By this decree the relations of the glass-house masters to their journeymen and apprentices was regulated and a special inspectorate was set up to solve disputes between them as the First Instance. A Chamber of Concession for the Land of Bohemia — with Prague as its seat — was appointed as the Court of Appeal.

Without knowledge and permission of this Chamber no apprentice could be accepted, and he received his certificate of apprenticeship only with its agreement and after proving his abilities to a different master than the one under whom he had trained.

For chalk-glass the period of apprenticeship lasted five years. For sheet- and bottle-glass it lasted four years and for plate-glass three years. Outstanding abilities and good behaviour could shorten this period. In the opposite case it could be extended, except for plate-glass.

During the first year the apprentice received half the usual wages, beginning with the second year already full wages; because some glass-houses had up to five apprentices at a time, which harmed the journeymen, the rule was now introduced that for each ten glass-pots there could be only one apprentice, the others were to be passed as qualified or if not suitable, sent to other work.

The extremely costly banquets were forbidden because as a result the journeymen were often thrown into debt for years. It remained the apprentice's duty to give only a barrel of beer and a ducat (for the roast) during the ceremony.

Only citizens of the country were allowed to take up apprenticeship, preference being given to the children of the glass-house assistants. Any person who could not bring a document of suitability was not accepted, for people ignorant of the trade would harm art and commerce, would produce bad wares, destroy forests, and would not prove useful to manor and state.

The journeymen were to be well-behaved to the masters, live on good terms with all others, carry out their work "without regard to their own profit", keep to working hours.

The master, too, was to behave decently to all his people, pay out wages within fourteen days, at least four gulden in local currency, sell them foodstuffs at market price, salt, beer, and clothing and keep good accounts.

The debts of the journeymen were to be deducted only in small sums. Journeymen were hired only on the basis of contracts which were prolonged per half year from St. George's Day to St. Gall, or were to be cancelled at four weeks' notice.

The glass trade depended greatly on the felling of timber and the general supply of fuel. The glass-house master, therefore, was to pile up one year's fuel supply so that it might dry properly and the drying places, with the danger of fires, might be abolished. Trees were to be felled near the roots and in whole clearings; especially old wood and wind-broken timber. Whereupon the forests were to be re-afforrested immediately. The masters were to keep a raw material reserve of three months and a potash reserve for one month.

When at the end of the eighteenth century the state control reached the point where they even took care of unemployed journeymen and glass-house masters, the acceptance of apprentices was forbidden without the simultaneous hiring of a journeyman.

In 1795 the "Gubernium" even considered a sort of pension fund from which the unemployed might be supported. At that time each journeyman received 25—30 gl. weekly. But the war prevented the implementation of this plan.

The Significance of the Glass Export

Finally our sources speak in detail about the extent of this branch. In 1731 exports were evaluated at 98 557 gl., a figure which seems very low and hardly credible. For at least two thirds of all production were exported and that would mean that the total production did not exceed 130 000 gl. More probable seems the information that sixty-four glass-houses manufactured 2.5 million gulden worth of glass-ware in 1799, of which three fifths were sent across the frontiers.

Four years later there were only two new glass-houses, but the traders themselves — no longer the tax authorities — evaluated the production at eight million, the export at five million, at least. More than 39 000 people earned their living in this way.

The Czech Encyclopedia for the year 1892 gives statistics whereby 17 500 workers in the different fields of the glass industry, in large-scale and small-scale manufactures and including cottage workers, produced 19.3 million gulden worth of glass, which for that time was a gigantic sum.

After 1918 ten Slovak glass-houses joined the Bohemian, Moravian and South-East Silesian glass-houses.

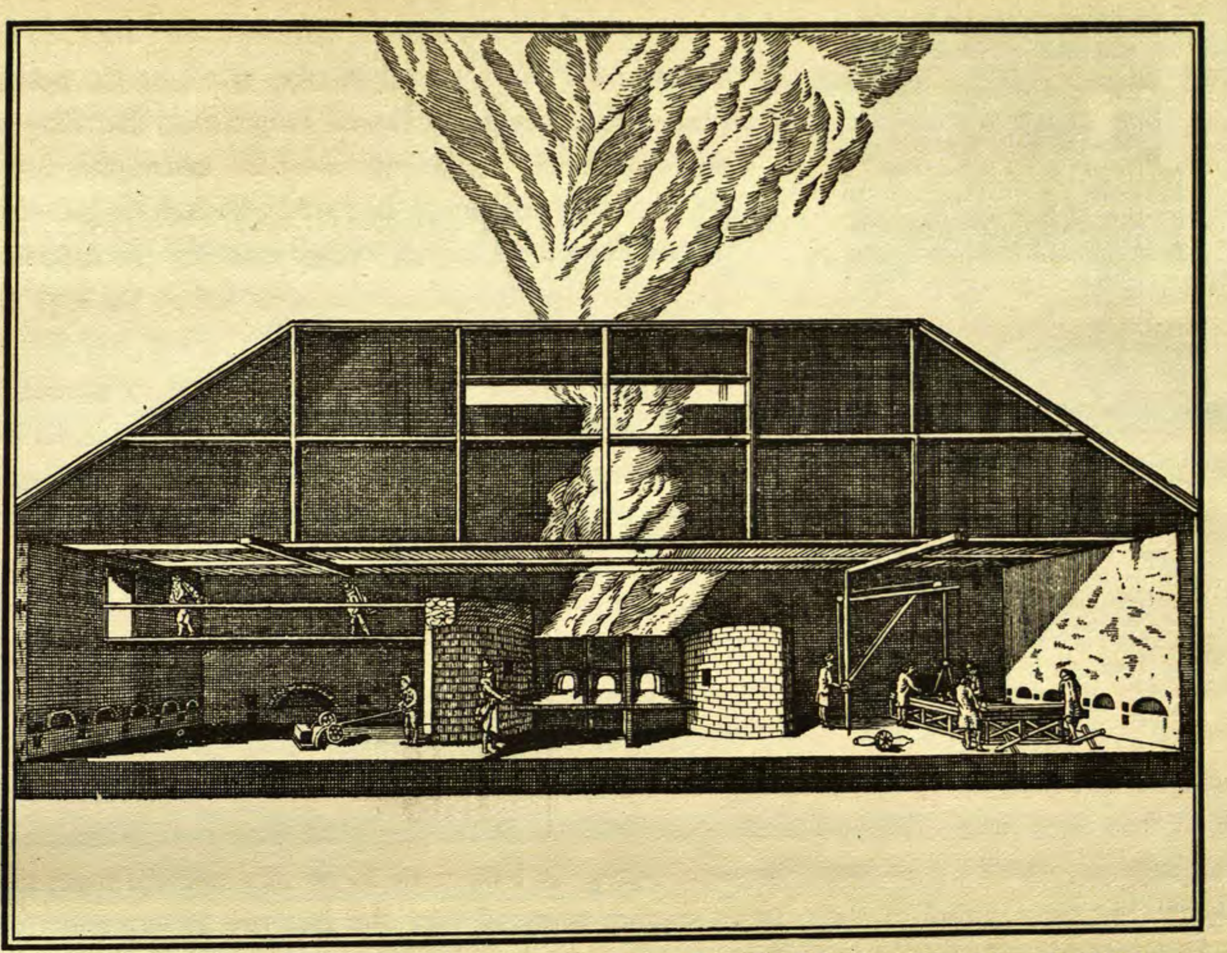
According to F. X. Jiřík, in 1934 more than 600 refineries worked in Czechoslovakia and there was an extensive cottage industry in North-East Bohemia. Altogether 100 000 to 150 000 persons must have earned their living by glass-making during the times of prosperity. Eighty percent of the production went abroad.

The orient was and remained an important market. Jiřík estimated that in 1920—32 17.5 milliard Czechoslovak crowns worth of glass was exported, whereby the necessary raw materials during those thirteen years cost barely half a million. Glass considerably helped to maintain the active trade balance of the Republic.

In the meantime the crisis approached. The world economic crisis broke out, and Czechoslovak industry was also laid off completely. The workers were dismissed, hungered, were desperate, and the exploiters simply buttoned up their bulging pockets.

V

AT HOME AND ABROAD



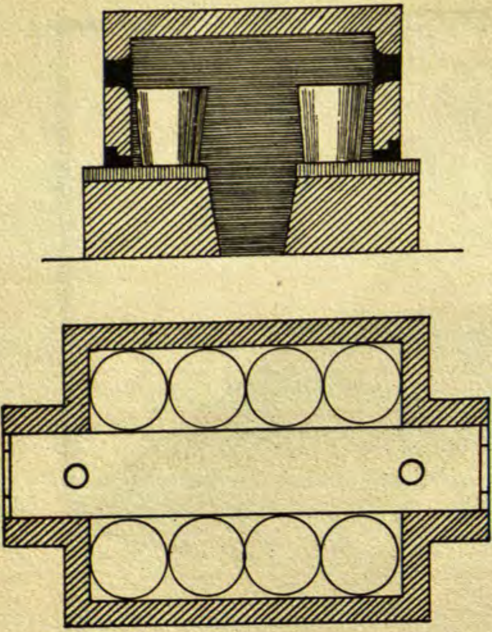
135. View of a glass-house producing plate-glass. About the year 1800. Reproduced from H. Schulz.

GREAT CHANGES IN THE WORLD DURING THE SEVENTEENTH TO THE NINETEENTH CENTURY

THE GREAT CHANGES in the world during those three centuries also brought great changes in glass-making. The impoverishment of the trade guilds during the Thirty Years' War brought a decline in the formerly advanced production technique and individual European states tried to lessen this in every way. The rulers were not so much concerned with the well-being of the population or their impoverishment as with the taxes.

These could no longer be extracted from the impoverished bourgeoisie which had been the best tax payer before. Every kind of attempt was made in the seventeenth and also in the eighteenth centuries to repair the straits of the feudal order as soon as possible. For this, use was made of the mercantilism, praised as a miracle medicine.

Finally Austria, too, began to help its disintegrating home industry and stagnant trade by limiting imports, stimulating the exporters into activity, yet without much success. The state bank continued to be empty. From this point of view one must look at the sudden "enlightenment" of our monarchs who forgot their past and opened the gates to foreign experts, even at the cost of admitting non-Catholics into the country.



136. Scheme of a German glass furnace.

So we see in 1775 that the Austrian state attracted glassmakers from Ferrara to Bohemia, and sent the Bohemian workers into foreign, advanced countries so that they might gain experience. They even rewarded inventions, not with diplomas but with money. In 1776 a premium for glass-cutters was announced. Following foreign examples the Austrian nobility now began to go into business, led by the high Bohemian aristocracy.

Since the guilds had a retarding effect on productivity, Maria Theresa and Joseph II made efforts to establish manufacturies which circumvented the trade guilds, working not for immediate sale, as it was the custom with individual workers, but en gros, for stock and for export.

With this, a purposeful division of labour began. The occurence of raw material and potential labour power determined the situation of the new workshops. The flight of the serfs from the country could not but break apart the still existing feudal order, and the new methods of production started a life-and-death battle with the social order. The workers were simply allocated to the manufacturers. In the first place from peasant families with many children, where the backward forms of tilling the land could in no case feed the many hungry mouths. The most gifted of these children were accepted into the factories as apprentices, sent abroad for specialisation to be able to serve as an example in the local production after their return.

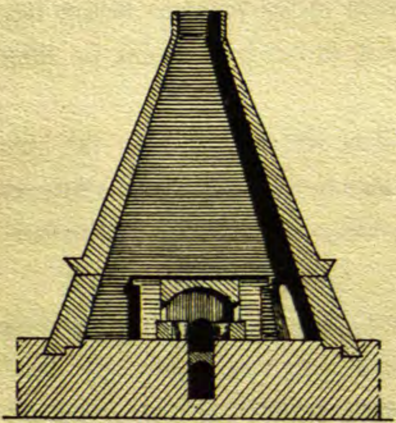
All this led gradually and logically to the Imperial edict of 1781, in which Joseph II abolished serfdom in order to tear down the dam of the feudal social order. The workers from the plains now streamed into the new enterprises whose number soon trebled.

In the course of the Napoleonic Wars the class contradictions sharpened; the small-scale industry and small town enterprises suffered considerably, whereas the army suppliers gained immeasurable wealth from the war.

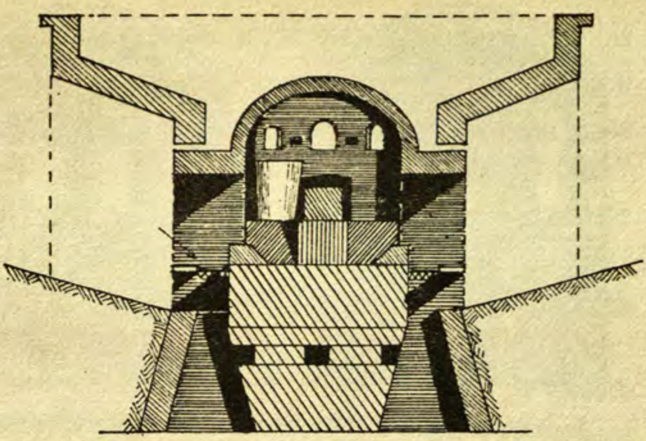
Franz I hated industry since he knew that it represented a melting pot of Liberalism, which had an inimical attitude to his absolutism. But he could not entirely suppress the new type of enterprises, even if he limited them on all sides. He needed their money which hardly anyone else could give him. Not only did he shy at the liberal ideas, but he had an almost panic-stricken fear of the proletariat, for in his aunt in France he had a living example of what he could expect from the newly risen class.

The pre-March proletariat in our country lived in unexampled misery, for it lacked experience and organisation. Its composition caused its lack of unity: for it consisted of a large strata of journeymen, also factory workers and day-labourers; only the journeymen even though bound by guild regulations were politically alert, thanks to their journeys through the politically more progressive Western countries.

The resistance of the absolute rulers could not stop the advance of Liberalism which had to follow the dying guilds and the system of "Concessions". The guild privileges gradually died out and soon



137. English glass furnace for "flint glass".



138. French glass furnace with indirect heating.

there was nothing which barred the way to the new factories, whose tasks no longer rested in the mere organisation of the cottage industry.

Probably as a result of the peculiarity of its sector of embellishment the glass industry, as a whole, remained far behind the general development of production. An Imperial decree of the year 1764 forbade the "glass manufacturers" — as the glass-workers were generally called at that time — to journey. Towards the end of the eighteenth century there were in Bohemia seventy glass-houses with five thousand workers and assistants.

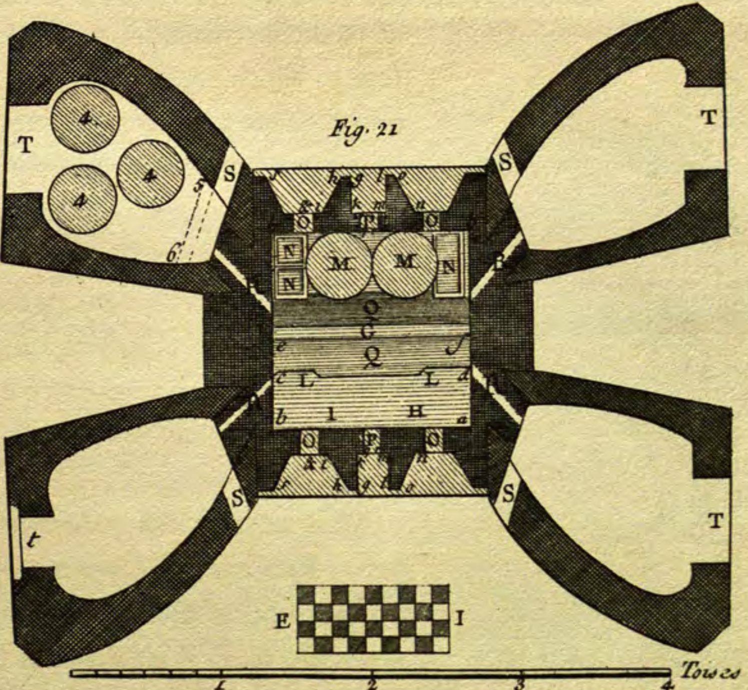
Napoleon's continental blockade caused an unexpected revival in the home industry, but after the withdrawal of the blockade there was a second, deep crisis not only in textiles, but also in glass-making.

The first had taken place after the death of Emperor Charles VI in 1740 as an accompanying symptom of the Austrian War of Succession which hindered export and was connected with the loss of Silesia. For it was in that district of the country that the raw glass was ennobled in the most excellent fashion, and its entire export was in the hands of the Bohemian exporters there.

The Peace of Hubertusburg in 1763 was a turning point. Now everything took an upward trend. Nor may one forget the increase of population which within six decades — from 1780 to 1840 — rose in Bohemia from 2.6 million to 4.1 million, without taking into account the numerically unknown losses during the Napoleonic Wars, where these were the results of epidemics rather than of battles.

Agriculture was crowded with workers and the great foreign competition of an industry that did not work at its full complement created in Bohemia, too, a "reserve army of the proletariat".

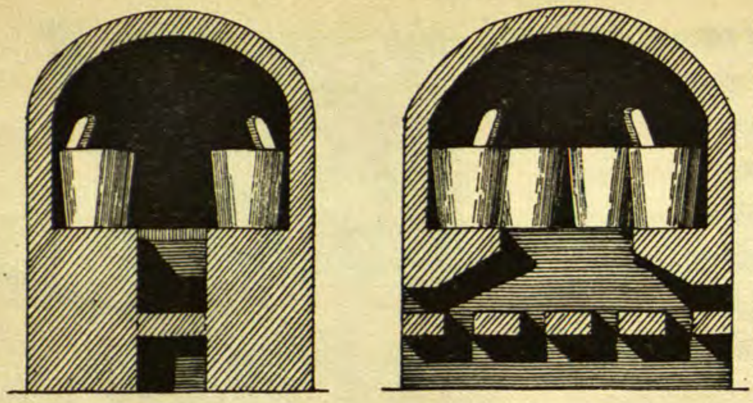
JOHANN KUNCKEL



139. Ground-plan of a French furnace for plate-glass. (The work at this furnace can be seen on the copper engravings in the supplement.)

Johann Kunckel was undoubtedly the most imposing personality of the German glass industry of modern times. His name is inseparably linked with the invention of the magnificent "ruby-glass" which after the decline of Antiquity had remained in oblivion for one thousand years, like so many other inventions by West Europeans.

Kunckel came from an old Hessian family of glass-makers who dated back to the year 1406. His great-grandfather was glass-house master in Wendebach; his grandfather immigrated to Holstein, where his father became the glass-house



140. Bohemian grate furnace for heating with timber.

master to the Count at Rendsburg. He was probably the Max Kunckel who led the Schirrensee glass-house (South-West of Kiel) in the middle of the seventeenth century and died about 1658.

Johann Kunckel was born near Rendsburg (1630). He learnt the art of glass making from his father. His wide interests led him to study chemistry, pharmacy and — as could be no other at that time — also alchemy. For a time he worked as secret chamberlain to Duke Franz Karl of Lauenburg and then as chemist at the Elector's secret laboratories at Dresden. Naturally he concerned himself with the making of gold. It seems that he did not feel quite at home in this strange occupation, even if he stated the contrary in his diary entries from the year 1677. He must have had enemies who intrigued against him. He went to Annaberg, and after his fortune had been confiscated he left for Wittenberg. There he tried to earn his living by giving lectures on practical chemistry. Finally in 1677 he was invited by Dr. Menzel, the Great Elector's private doctor, to come to Berlin.

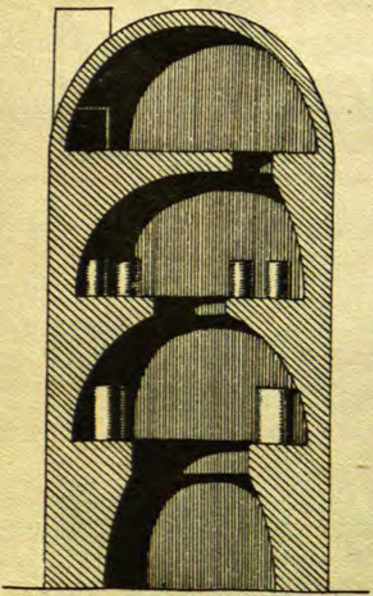
Soon he gained the confidence of the ruler of the country and a year later became his secret chamberlain. He abandoned alchemy for good. Now he left these useless fantasies for diligent studies in practical chemistry and began to concern himself with the problem of glass-making. Already on August 2nd of the same year, the crystal glass-maker in Drewitz received orders to assist Kunckel in every way, and barely eleven months later the latter rented the entire glass-house for three years.

On the so-called Hackendamm in today's Neudorf near Potsdam he erected a special workshop which was later named after the town. The old Drewitz glass-house ceased to function 1688. Kunckel had invented his famous "ruby-glass" already at Drewitz in 1679, as he informs us in the first edition of his „Ars Vitraria Experimentalis" (or the "Perfect Art of Glass-Making") published in the year 1689.

But in his last work "Laboratorium chymicum" he says: "It started in this way. There was a doctor of medicine, named Cassius, who invented the praecipitationem solis cum Iove to which perhaps Glauber gave instigation, with which I do not concern myself. This Cassius tried to put this into glass but when he wanted to form a glass or when it came into the fire it was as clear as other crystal and he could not get a permanent red. As a curious man, this person may have observed from the glass-lamp blowers that by malaxing in the flames the colour of the lamps was different from its normal, whereupon he wished to try this and gained the most beautiful ruby colour. When this came to my knowledge I immediately tried my hand at this, but what difficulties I encountered to find the right composition only I can know. Now that it has become common knowledge it is so easy . . ."

What actually was the problem here? It was to conclude an old feud between Kunckel and Cassius over the invention of "ruby glass".

This kind of glass was of immense importance in the history of baroque glass. Dr. M. B. Wolf wrote in this connection: "A glass-maker's legend from the Bohemian glass-houses says that "gold ruby" arose out of the love of two young people who threw their engagement rings into the molten glass."



141. Ceramics kiln with three floors.

In reality, however, "gold ruby" is the child of alchemy, the belief in the catalytic influence of the glass and gold melting during the preparations of the elixir of life and the stone of wisdom. The ruby glass met the baroque alchemist tendencies; the mystical inclinations of this period found in it their material form; the faith of the iatrochemist Paracelsius, who was of the opinion that "gold ruby" beakers added healing power to the juices and drinks. Therefore many "gold ruby" goblets have been preserved from the baroque period.

But this glass also contained the tragedy of its inventor. He was accused of having coloured it with the blood of human beings and convicted of black magic and only the favour of the nobleman in whose services he stood saved him from death at the stake; so that, indeed, human blood was almost connected with it. Here it should be mentioned that only Fuss in 1836 gave the first closer information about the purple red colour of the "gold ruby", this truly "royal" glass.

The "gold ruby" glass, melted by Kunckel, was decorated by special glass-cutters in a special way which we do not find on ordinary glass. "Gold ruby" was often set in pure gold, just like semi-precious stones. The Drewitz glass-house master, Jobst Ludwig, moved with Kunckel to the new glass-house where for many years he was his most important collaborator.

Kunckel became the declared darling of the Grand Elector and received from him in 1685 the "Peacock Island" as a present on which he built his own private glass-house for his experiments in order to be able to hide the secret of "gold ruby" the better. Moreover, together with Ludwig he was granted a concession for the production of crystal-glass and alone the right to produce "ruby glass", other coloured glasses and also corals for the Guinea Company.

After the death of his patron in 1688 misfortune befell him. Both glass-houses caught fire, the one on Peacock Island burnt down completely.

In August of the same year he was surprised by the order of the new Elector, Frederick III, to account for the rest of the large sums which he had received from his predecessor. The long drawn-out investigations could not convict Kunckel of any fraud, but all the same, the ruler of the land demanded the back payment of eight thousand thalers.

To raise this sum Kunckel sold his house in Berlin and retired to his estate. The glass-house on the Peacock Island was not rebuilt and he withdrew from the Potsdam glass-house. But because the Elector was not willing to dispense with this luxury manufacture and because in fact there was no other suitable person for its management, Kunckel renewed the lease in 1690. This time for life, but he does not seem to have cared for it any more. Two years later, the French emigrant, Simon de Tournay, who had worked in glass-making in his own country and in Düsseldorf, offered to produce not only crystal glass but also sheet-glass. Tempted by this, the Elector had two hundred thalers paid out to him for his experiments and ordered Kunckel to get the Potsdam glass-house ready for the Frenchman "and to help him in all friendliness wherever necessary".

This presumption had a crushing effect on Kunckel, but fortunately the invitation of the Swedish King Charles XI to Stockholm saved him from this humiliation.

In the spring Kunckel accepted this honourable offer; during his five months' stay he acquainted himself with the problem of mining. He returned as a Royal Swedish Mining Adviser with the noble title Kunckel von Lewenstern. From then on he no longer concerned himself with glass-making.

In 1694 he changed his estate near the Havel river for a farm in the Niederbarnim district. Apart from several long journeys he spent the last nine years of his life there. He died on March 20th, 1703 in fairly shaken financial conditions. It is not known where he died.

The only piece which, as a result of its decorations, can definitely be ascribed to Kunckel's Potsdam activities is a faceted beaker with a lid and with the monogram of the Count Johann Georg von Anhalt who died in the year 1693. There are some other individual pieces in the Museum in Hamburg, in the British Museum and in the Mühsam Collection.

It is strange that no piece with the Berlin silver setting has been discovered. We have a considerable number of bottles, partially engraved with fruits, tendrils and birds' heads from his earlier period.

Russian Glass Production in Modern Times

In Russia, too, modern glass production dates back to the seventeenth century. The first glass-house is said to have been erected in 1635 near Voskresensk in the market town of Dukhanino.

Some thirty years later, a second glass-house was established in the village of Izmajlovo, not far from Moscow, where the output was of far better quality.

On Potemkin's instigation a glass department was installed in the Imperial Russian Porcelain Manufactury in St. Petersburg in 1777. This glass department supplied exclusively the needs of the Czarist court, just like the china factory itself. It had two furnaces with two pots, each with a content of 500 lbs. Around the turn of the century only the popular lead glass was produced in them.

In the eighteenth century there were already six glass-houses around Moscow and in 1752 Professor Lomonosov was granted "permission to erect a factory for the production of multi- coloured glass, corals and other jewelry, for the duration of thirty years."

In the sixties of the eighteenth century two larger glass-houses opened up which are still in existence today.

The nineteenth century brought a rapid increase in the number of glass-houses and in 1913 there were already 275 glass-houses in Russia with 73 000 workers and a total production amounting to sixty-five million rubles.

In spite of all this, this branch of the light industry was not sufficiently productive, for only ten tc fifteen establishments could be considered up to the standard of the time, and in this sector Russia held only the eleventh place among the other European countries.

The coming to power of the Soviets changed this situation at a truly revolutionary speed. In Daghestan the first completely automatic enterprise for vertically-drawn sheet-glass was opened in 1926. It was rapidly followed by a second, even larger establishment in Konstantinovka in the Ukraine. This possessed twenty machines; i. e., it was the largest enterprise of its kind in Europe. In 1936 there alone eleven million square yards of sheet-glass were produced which is more than double the entire Russian output for 1913.

Other gigantic works grew up in Gusj, Tchagodoshtshensk, Gorki, Gomel, Ulan-Ude etc. which together produce a further 92 million square yards of sheet-glass. For the production of bottles, preserving jars etc. new factories were built at Cherson, Ordshonikidse and other places. Somewhat later, the glass factories for other types of glass products were mechanised; e. g. factories for electrical bulbs, technical glass, etc.

In the course of the gigantic Soviet Five-Year Plans the entire glass production was re-organized from top to bottom and equipped with the most up-to-date technique, so that the glass industry in the Soviet Union attained the first place in Europe, surpassing the famous old industries of Germany, Italy, France and Belgium.

The Glass Works at Gusj

One of the most important glass combines in the U.S.S.R. is, undoubtedly, that at Gusj which looks back on a two hundred year old history. It is not only a monument of the past but also an example to the others in the transition from the Socialist to the Communist society.

The works lie at Meshtshor on the river Gusj in the centre of untouched virgin forest and near large deposits of glass sand. Round the forest glass-house once numerous wooden log huts had been erected as living quarters for the glass-makers who were recklessly exploited by the noble estate owners. As in the old Bohemian glass-houses so also here the glass-makers toiled from sixteen to eighteen hours daily until complete exhaustion. The unbearable radiation of the primitive furnaces which filled the barn-like workshop with gases and burning smoke caused by the smouldering wood, scorched their hands and faces, and the flames blinded their eyes. When they could bear it no longer, the workers would jump in their dirty rags into the glass-house pond to return, a few minutes later, somewhat refreshed to their tiring work at the furnace. These, to us almost incomprehensible, conditions forced them to protest actions and often to strikes. In their desperation they once sent a petition to the Czar, but the owners' spies betrayed the action; the leaders were tortured and exiled to Siberia.

The Gusj workers will never forget the mass strike in 1898 when a punitive party coloured the streets of the village red with the blood of the workers.

The history of the Gusj works is not only closely linked with the fighting of the working class in Czarist Russia but also with the peak of glass-making. We have in mind master Subanov who for three generations led the glass-cutters in the country.

For their patterns they used the hoar-frost which created bizarre patterns on their windows. They copied these and their "hoar-frost" glass was in great demand. Other workers grew up here, of whom we might mention Opantin, Skatshkov, Kuskov, Kalmykov, Novsky, Lebedyev, all of whom have become famous for hollow cutting and masterly engraving.

The victorious Socialist Revolution gave a new content to the Gusj glass-makers' art. All over the Soviet Union everybody knows the vases "Thirtieth of October" and "Eight Hundred Years Moscow" as well as the cut-glass bowl for the seventieth birthday of Generalissimo J. V. Stalin and the many other admirable works of art. Later a one-and-a-half yard high crystal vase of special refinement was presented by the youth of the Vladimirov district to the leader of the working people of the whole world.

Today the Gusj works bear not the least similarity with the former manufacture of the Counts of Maltzov. In 1930 the glass factory was completely rebuilt and re-organized. In the workshops a water and air cooling system was laid, automatic glass pipes, presses, mixing machines were installed and all out-of-date and old-fashioned machinery was removed. Today the works form the centre of a considerable town. The workers receive the necessary technical schooling; magnificent crystal vases, jugs, glasses, dishes and other objects are made here. Further there is a workshop for pressed glass in its most beautiful forms; excellently equipped cutting workshops in which crystal-glass is etched and the department of glass-painting leave nothing to be desired.

The famous Stakhanovite Shestakov was the first to bear the Order of Socialist Labour in the glass industry; Gorbatov and many other Heroes of Labour belong to the works. The norms are constantly being overfulfilled by two hundred and more percent. With the works also the appearance of the town has changed. New enterprises for technical glass have arisen, also sheet-glass factories, works for safety glass for cars and fibre-glass production. The most recent invention is the so-called "Stalinite glass" which is produced here, of which a pane laid between two chairs bears the full weight of a man; it is completely unbreakable.

The furnaces are automatic, the temperature is thermostatically regulated, there is no need to cart raw materials. The raw material supplies are mechanised. No wonder that 98% first quality glass is produced, an unconceivable percentage in glass-making.

The works are simply swamped with orders. At the moment they are working on the production of special gigantic sheets of glass for the Moscow skyscrapers as well as for the gigantic constructions of Communism.

For us it is interesting to note how the Soviet people love their glass artists, how side by side with the building of that gigantic glass industry they also care for their artistic glass production and improve the latter, for under Communism the people want both good and beautiful things . . .

The Oldest Glass-House in Slovakia

The owner of the manor house in Sklené Teplice offered his estate for sale to the (Hungarian) king. In this offer he made a special point of the fact that a glass-house belonged to his estate which had been supplying glass for two hundred and twenty years to the royal minting towns of Kremnica and Banská Štiavnica.

This document was written in 1550 which would mean that the glass-house had already been functioning in 1533. If we compare this date with the oldest documented Bohemian glass-house in the Bohemian Forest, then Slovakia would have the advantage of a few years. This is problematic but the document proves that a glass-house must have existed in Slovakia about 1360.

In that year Peter Glaser or Gläser founded such a glass-house near Kremnica and his concession was confirmed on April 29th, 1360 by the Diet of Turčanský Sv. Martin. In the same year, Glaser was granted the right to fell timber in the virgin forest at Čierna Hoľa. In honour of the founder the place is called Glaserhau, in Slovakian, Glézerova Lehota.

A second document, from the year 1620, states that a new glass-house had been erected at Nová Baňa on the river Hron. The little town was very helpful to the master, Ulmb, not only by granting him a loan of 2 400 gulden but even paying his travelling expense of 35 thalers. He was allowed to repay this credit in glass. From this it can be seen that there was a lack of glass-makers in Slovakia, for other craftsmen had to pay considerable sums before they were given residence permits.

In 1678 the Countess Pálffy (née Harrach) — i. e. from Bohemia — rented a glass-house to glass-maker George Bauer near the town of Modrá.

In 1707 Count Rákoczy ordered glass-makers who were working in his establishment at Stupava to move to Mukačevo (today in the Soviet Ukraine) to produce "fine glass" there. These sources reveal by the family names that the Slovak glass-houses were founded mostly by masters from the Moravia-Slovakian border areas. But gradually these immigrants assimilated to their environment so that today the glass-makers names are local.

At present there are seventy glass-houses in Slovakia, mainly situated close to the sources of raw materials. Where these were exhausted the glass-houses usually decayed. Most of them — about twenty — were in the Lučenec - Detva district. Today there are eight works that mass-produce glass-ware, the largest of which was founded in 1892 by Joseph Scheiber in Lednické Rovné.

In the middle of the eighteenth century the rococo style reached its highest development, replacing the baroque which had become out-of-date. It came from France "where already since the thirties there had been growing attempts to hide the constructional units of architecture under exuberant decorations."

Glasses, covered in a black enamel colour with gold ornaments, came as forerunners. The originator of this style was the gifted glass and china painter Ignaz Preissler (1676—1741) who lived as painter to Count Kolovrat-Liebstein at Kunštát in Eastern Bohemia.

Double-walled glasses, too, were popular at that time. They had already been produced in old Rome but with the difference that now the engraved gold leaf was no longer stuck to the glass and covered with a further layer of viscous glass but that a second, exactly fitting inner vessel was inserted into the outer glass and the two were cemented together at the rim.

The cutters of the baroque and rococo glasses managed to give magnificent ornaments to these double-walled glasses so that they gave the impression of a single thin-walled vessel. The oldest products among these leave a strange impression; they were sometimes ornamented with oil paintings which Kunckel described who left us detailed instructions. During this epoch of most extravagant luxury they were very popular. Towards the end of the eighteenth century the decorations of Antiquity with engraved gold leaf became popular which were frequently carried out by the most talented artists. Their motifs were in great demand so that they were copied secretly.

Roughly at the same time painting on milky glass became the fashion as an imitation and replacement of the newly invented and extremely expensive china. The double-walled glassed disappeared gradually but gold painting continued. It was carried out in such a way that an oval or round notch was cut into the surface of the vessel into which an exactly fitting plate was inserted which on the bottom had been varnished or gilded.

Johann Josef Mildner in Guttenbrunn in Lower Austria was outstanding in this art. He is alleged to have been an immigrant from Silesia. Another master was the silhouette painter, Johann Siegismund Menzel from Cieplice Sloskie. They were contemporaries.

Opaque enamel painting ceased completely during the second half of the eighteenth century and its place was taken by painting with transparent glass colours. The Dresden china and glass masters Samuel Mohn (1763—1815) and his son, Gottlob Samuel, were outstanding masters of this art, who after studying in Leipzig and Dresden, worked in Vienna from 1811—1825. Both were primarily landscape painters, worked, however, very rarely themselves, mainly supervising their workshops. The illustrations which the younger Mohn painted on glass and which were in great demand in Vienna were developed further by Anton Kothgasser (1769—1851), the painter of the Vienna porcelain manufacturies. His flower tendrils and allegorical scenes on souvenir and "friendship" glasses reached the highest level in this art. He was imitated in this for a long time by F. Egermann.

DOMINICUS BIMAN

THE BEST PORTRAIT ENGRAVER

Born in 1800, the son of a carpenter and form-maker in the Harrachov glass-house in Nový Svět and of the daughter of a bricklayer, this child of the proletariat learnt first the trade of glass-polishing and painting. Even during his years of apprenticeship his talent was so outstanding that in 1826 he went to the Prague Academy of Painting. The magnificent portrait of Count Kaspar Sternberg, engraved on a sheet of glass, belongs to his study period. In 1829 he settled in Prague as an independent glass-engraver. That is perhaps the only case in Bohemia of an artist daring to earn his living independently without hiding himself behind the business label of a refinery. He spent his summers in Františkovy Lázně(Franzensbad) where rich foreigners overwhelmed him with orders for their portraits or landscapes engraved in glass. He used the popular intaglio cuts for this.

It is worth mentioning that G. Pazaurek, who devoted an entire chapter to Biman in his "Gläser der Empire und Biedermeierzeit" discovered the uniqueness of his art in — Russia where he took part in a Congress. There in the houses of the noblemen he saw some typical works of Biman's which the Russian Grand Dukes and German princesses used to take home from the spa Franzensbad. His portraits in glass are unsurpassed to this day and might serve as an example to many future generations of engravers. Biman died young in 1857 and was not really discovered until after his death.

FRIEDRICH EGERMANN

F. Egermann was born in 1777 in Šluknov as son of an elderly magistrate of the Harrachov estate. His mother belonged to the famous glass-maker family, the Kittels. It is not known why the child at the tender age of six weeks was sent away from the family and grew up among strange people, in indescribable hunger, direst poverty and suffering maltreatment. In the well-known "potato war" — 1778-79 — the boy was taken to Germany by Prussian soldiers and he was returned to his fostermother only after official intervention. At the age of seven he was bitten by a rabid dog and for a year he lay between life and death. Finally this poor creature was taken pity on by his mother's brother, the Dean of Chřibská, who took him into his household more as a servant than as a pupil.

At the age of fourteen F. Egermann tried successively a number of trades, without showing any special talent until he came under the strict supervision of his mother's second brother who taught him glass-painting and cutting. After his apprenticeship he ran away to Germany where, after many adventures without papers, he arrived in the strongly guarded Meissner Castle where the Elector of Saxony was hiding his jealously guarded porcelain manufacture.

As a poor reed-binder and scissor-grinder, pretending mental defectiveness, Egermann was despised everywhere and . . . suffered. In this way he became acquainted with the fundaments of porcelain painting, gained the necessary knowledge about the marten brushes, patterns of colours, fashionable painted fragments and finally even got possession of a recipe book.

He returned home with a troop of travelling actors, back to unemployment from which he had fled. In order not to be idle he learnt drawing and painting at the Piarist College in Bor and tried by and by to introduce his new independent ideas about glass-painting. He was crowned with success, his diligence made an impression, they began to copy him in his environment. This problem of the first period of Egermann's work becomes intelligible when one takes into consideration how Egermann, like all other North Bohemian glass producers, was absolutely hypnotised by the triumph of Böttger's invention.

Glass-makers tried to learn this invention at all costs, and began to produce the bone (milk)-glass with which they conquered the English markets. The Bohemian painters who decorated the milk-glass did not know fine colours and revealed their lack of schooling with their hard badger paint brushes. Instead of "painters of coats-of-arms" they were called "colour dabbers".

Egermann brought home from Saxony first of all the knowledge of the refined technique of porcelain painting. The Meissner manufacture under the management of Camillo Marcolini was at that time fighting its battles against the English Wedgwood china and was changing from rococo to the modern Empire styles.

Egermann's water-colour paintings on square and oval-shaped milky sheet-glass which served as transparent shades for the modest lighting arrangements of the time originate from that time. They were copied from those which the famous porcelain factories successfully brought on to the market at incredibly high prices.

The world-famous invention of the Buquoy black hyalite glass did not give him a rest; he began to study the chemistry of glass and it was here that he gained his immortal reputation. His first true invention was agate-glass in 1808. Two years previously he had married the daughter of a lustre manufacturer, Schürer. In 1809 he exhibited his agate-glass which he had perfected with the help of the son of the chemist Hieke. In 1824 his "mother-of-pearl-glass" and his "biscuit-enamel-glass" came out. These inventions ensured him temporary employment under Count Philipp Kinský, for whose famous mirror glass he made frames which were decorated with the above-mentioned kinds of enamel. Today their production process is again unknown.

In 1817 he invented a new method of a dull polish for crystal-glass; in 1819 he added his "marble-glass" to this and finally in 1820 the long-forgotten silver glaze, a yellow mordant which made him famous overnight. He not only invented his glazes but also discovered methods of cutting it so that he produced two-coloured enamelled glasses.

These early glasses did not have the Egermann motifs that were later endlessly repeated, which he first applied to his panel cuts by using a "wire hedgehog" which he had invented himself. A yellow glazed glass from the year 1820 shows no trace of the ornamentations that were to become so common later.

His most valuable invention from the point of view of the history of art was the "lithyalin glass" which he patented in 1828. But this made him more famous among the collectors than giving him great material success. He continued to perfect his inventions, learnt to glaze the "lithyalin glass" with silver and other colours, to engrave, cut and gild it.

Many of these pieces represent the very peak of glass-making in the first half of the nineteenth century. But it is a very brittle matter, hardly useful for industrial purposes. In practice it remained a rarity even if it was to be produced later in Russia and after the First World War also in Czechoslovakia. But these later products never reached the magnificent forms, the rich and fine veins, the elegant glazes and refinement. For each of Egermann's products represents a masterpiece in itself.

Pazaurek, moreover, maintains that "lithyalin" actually was not one type of glass but a whole variety of glass. The repeated tests and experiments of Ing. Bachtík have proved that the transparent "lithyalin" is a special sort of pure white glass with supersaturated glazing, whereas the opaque represents a glass coloured in the mass and glazed only subsequently.

After sixteen years of experiments which were morally and financially exhausting, Egermann solved the secret of "ruby glass", the copper glazing, his most outstanding and most valuable invention.

"Gold ruby" had always been by far the most expensive glass because pure gold had to be mixed into the glass mass, the gold having been first dissolved in aqua regia. The glass assumed a magnificent purple or garnet-red colour only after annealing and even today it requires great skill to attain really good "ruby glass", for the smallest omission gives the glass a so-called "freckle". The addition of pure gold made the glass immensely dear. No-one will wonder that after the long years of the Napoleonic Wars, the state bankruptcy in 1811 and the deep crisis in glass-making which increased as a result of the long continental blockade, and the victorious advance of the English lead-glass with its magnificent lustre and cut, there was a shortage of the necessary gold ducats for the colouring of the glass.

It was an accident that revealed to Egermann how glass could be coloured red. In the glass-house producing milky glass they used to collect dog faeces which were then dried, heated in the annealing furnace, ground and used as a basis for enamel colour painting which consequently adhered better to the glass. Once during the preparations of such roasted dog dirt a worker threw at Egermann's feet a minute fragment of glass which, on first sight, looked as if it had been contained in the excrement. Egermann saw the hitherto unknown colour of this red piece and quickly picked it up. At home he discovered that he was dealing neither with glass coloured in the mass nor with a red painted fragment, but a piece of glass on which a hitherto unknown glaze had been etched. At that time he did not know that glass sprinkled with copper vitriol had received a glaze in the furnace into which apparently it had been thrown. Now Egermann started an infinite number of experiments and tests which took up sixteen years of his life, swallowed up all his savings and his entire wages because right to the last moment could he not imagine how "ruby glass" could originate from a different metal than ducat gold.

Finally he reached his goal — again by accident. A fragment of glass that had been influenced by a solution of copper vitriol and had then been forgotten in the furnace underwent three processes of heating; during the third time circumstances proved victorious, for the old furnace was no longer in a good condition and let through the coal gas. That was the secret of Egermann's "ruby glass". It took a further six years until he succeeded in repeating the experiment and in finding the correct proportions as well as a glass suited for this procedure.

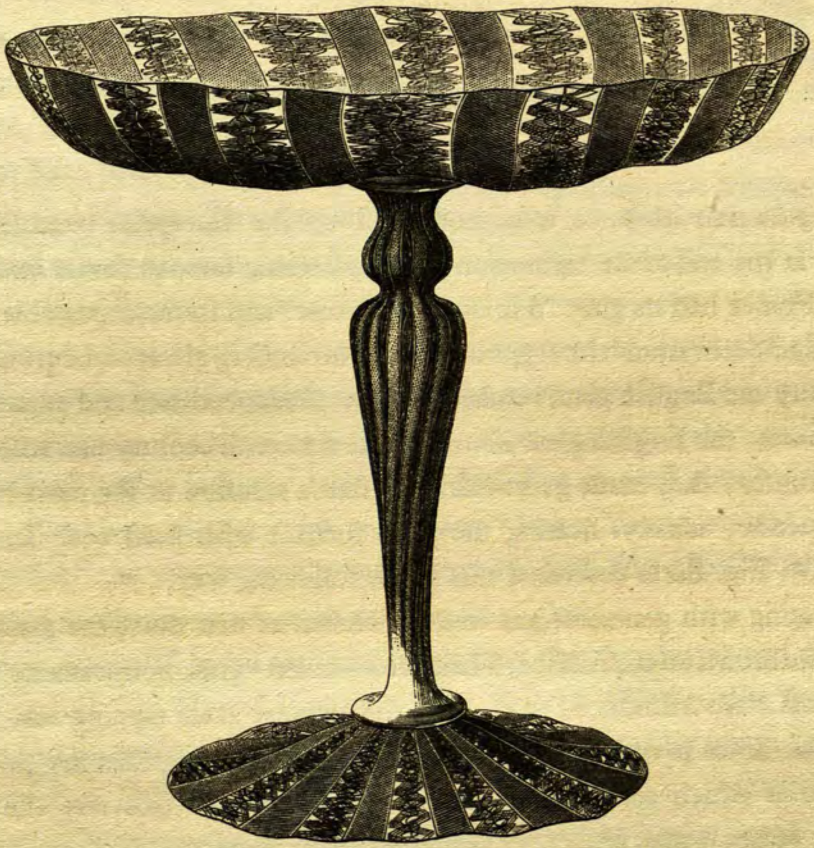
His invention of the red-white glass, incomparably cheap in production, soon caused a sensation; and his competitors stole his secret before he could patent it. Yet until his death at the age of eighty-nine years he remained the only one who managed to produce perfect "ruby glass"; for his treatment of the glaze had remained his secret.

His life story reads like a novel. He survived an explosion in his laboratory which almost deprived him of his eyesight; he lost his entire fortune several times; this and other events show that he lived a full life to his old age. It was he whose constantly new coloured glasses and glazes revived the reputation of the Bohemian glass that was rapidly sinking. It was he who for half a century was the driving force of the entire North Bohemian glass industry. His suggestions and inventions had such an influence on the glass producers that they stimulated the inventions of many new types of compositions and embellishments. Therefore in the full knowledge of its significance one can set down the assertion that the North Bohemian coloured glass and its victory in the nineteenth century can be traced back directly to the genius of Friedrich Egermann.

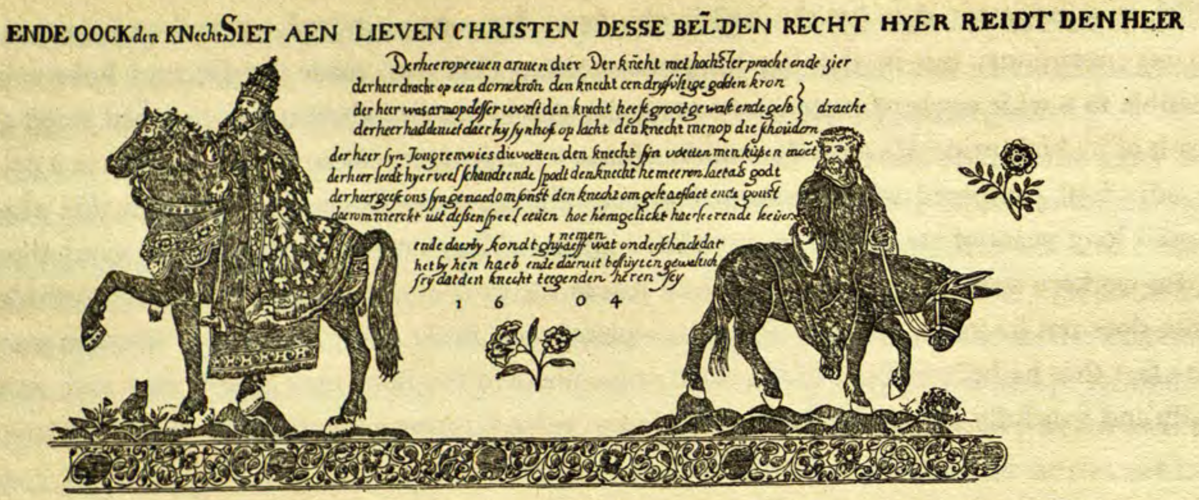
Egermann's rise from a modest glass-painter's apprentice to a famous master who was sought after by the Emperor and all the notabilities of the entire monarchy, admired by the entire cultured world — this Nestor of the Bohemian glass industry — that, indeed, is a rare life story during the first, progressive stage of capitalism.

The middle-class historians of art had to acknowledge Egermann's services, but they repeatedly tried to lessen the importance of his many-sided and unique personality. They compared him to the most famous glass and porcelain-painters in Vienna and Berlin, but accused him that his great inventions, mainly the glazes, endangered the hitherto unattainable production of Bohemian artistic glass, that he replaced them by the production of cheaper, prettier glasses which were no longer desired by the salons of the rich middle classes.

With this judgment they hit the nail in the head. Egermann, indeed, opened an immense boom with his inventions; but in this lies his great service. This man made the precious Bohemian glass accessible to a wide circle of customers among the simple people, whereas before it had stood aloof as a result of its high price. He gave the middle classes a fashionable, coloured, simple glass at a price that was ridiculous compared with the former prices. The aesthetes forget that this high tide of success followed long years of stagnation in our glass industry. They do not remember that many thousands of glass-workers were given their daily bread just at the time of their direst misery. Egermann's significance does not lie in his masterly ability as a painter nor in the invention of the "lithyalin glass" but in the fact that he bellowed the fire in the dying embers of the Bohemian glass-houses and, moreover, greatly and fruitfully influenced the shapes of glass vessels during a whole epoch.



142. Venetian "tazza" with complicated filigree threads. Slade.


ENDE OOCK den KNecht SIET AEN LIEVEN CHRISTEN DESSE BELDEN RECHT HYER REIDT DEN HEER
1604

143. Opened-out diamond cut drawing and inscription on a Dutch goblet from the 17th cent.: The Pope on horse-back and Christ on the ass as a beggar. From the year 1604. Museum of Antiquities at Amsterdam.

THE REST OF THE WORLD

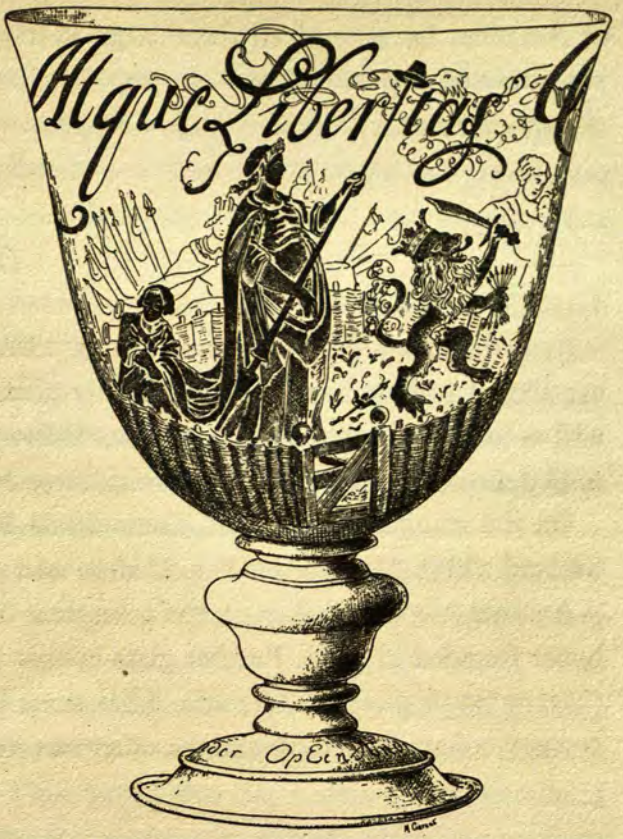
We may not forget that we were not alone on the European continent, that there was Dutch glass which at the end of the eighteenth century became famous for its exclusive beakers with diamond stippling; France had its glass "à la façon de Venise" and its unsurpassable cathedral windows; Germany had its magnificent Brandenburg, Saxon and Nuremberg glass; and during the second half of the eighteenth century the English glass reached complete independence and expanded in an unprecedented manner. Whereas the English glass-houses of the sixteenth century had still copied the Italians, in the seventeenth century they made great efforts to find a solution to the most burning problems of modern glass production, namely: heating the glass furnace with hard coal. In 1615 they reached success. Professor Dr. Ing. Bárta described this in the following way:

"The indirect heating with generator gas was not known at that time; the glass, melted with coal, had stains and became brown on the surface; it had the so-called "glass-house smoke" caused by sulphur. Therefore closed pots were introduced to prevent the exhaust gases coming into direct contact with the mass of the glass. Since it was difficult to achieve high temperatures the production of a softer glass was introduced in which chalk was replaced by cinnabar. In this way the lead-glass with its beautiful refulgence arose; it was, in fact, an answer to an emergency."

This "English" or "lead" glass spread in the course of the eighteenth century all over Europe, indeed, all over the world. It was given an intaglio cut so that its greatest merit, its intense lustre, stood out all the more impressively. Since it was considerably softer than other glass this type of refinement suited it ideally.

The oldest glass-houses in Eastern Europe, apart from Russia, were in Poland and Lithuania where already in the fifteenth century glass was being melted under a crown monopoly.

Such an enumeration may not leave out Spain. Since Roman times, and probably in unbroken continuation, Spain had been producing glasses on the Venetian model. These were primarily glasses with indented decorations and even "net glasses". Even if they did not reach the fine forms and colours of their masters they frequently excelled in fantastic shapes and rich decorations. Of course, it cannot be asserted that the Spanish glass followed only the Venetian model. It united, on the contrary, two basic influences: the Venetian and the Oriental, primarily Moorish. In spite of its own excellent output, Spain was one of the most important markets for Bohemian products. Its harbours served the Bohemian glass as a spring-board to the world.



144. Magnificent glass drinking vessel with a diamond-engraved inscription demanding Dutch independence. 17th cent. Museum of Dutch Antiquities, Amsterdam.

Sweden

Dr. Josef Matějka asserts that Swedish documents have been preserved from the early Middle Ages which bear witness to their knowledge of glass-melting and hollow-glass blowing as well as to the production of smaller window panes. The fact is that in the fourteenth century there were already glass-makers in Stockholm, Upsala, Kalmar and Visby. Their output can not have been significant because the import of Dutch and Brabant glass was under discussion. The import of ancient Kiev glass during the time of the Dukes has already been mentioned in the chapter on Russia. The Swedish king Gustav Vasa tried to assist the glass industry of his country. He called masters from Germany and Poland, who significantly advanced Swedish glass-making by introducing many novelties as well as by their personal diligence. In the seventeenth century one can speak of a glass industry here. The first documented glass-house was founded by master Pafrel in the Kronborg district. Not much later Metker Young erected a glass-house in the Stockholm "Djuragarden"; he was granted a concession for founding glass-houses in Sweden and in 1641 he even succeeded in obtaining a ban on the import of glass.

But he was not very successful in his undertaking so that the glass-house had finally to be handed over to his son who moved it to Nystad (Savonlinna) in Finland which at that time still belonged to Sweden. But his son had no better luck and the glass-house was gutted by fire in 1685.

On the instigations of an Italian beggar monk, Bernardini Scopitta, a company was set up in 1675 for the erection of a glass-house in the North of Stockholm. But the beggar monk, who called himself Marquis Giacomo Engamini, was an impostor who in the end absconded with 5 000 German thalers. The glass-house continued to change hands until Karl XII put it up for auction in 1704. In the eighteenth century many glass-houses were set up, some of which are in action to this day, having, however, to fight hard against competition, especially from England.

The main difficulties of the Swedish glass industry are the results of the lack of good sand; the best in the country is found in the Westgotland province (Kristiansund) and it contains on an average 0.3—0.5% iron so that it is virtually useless for the production of crystal glass. For better glass, therefore, sand has to be imported from Germany or France. Lime in the form of chalk is imported from the island of Rügen, soda from Central Germany and the lead compounds from Great Britain or America. In spite of all these basic shortages the purposeful work of the Swedish glass-makers has extended this branch into an important sector of the national economy, in which, especially in the sphere of artistic glass, it plays a significant role in world production.

Denmark

According to documents, already in 1572 there existed a glass-house in Central Jutland and others are alleged to have been founded shortly afterwards near Helsinor on the island of Seeland. Here as well as in several other later enterprises hollow glass was produced. But all of them closed down again so that until 1825 there was no glass industry in Denmark.

On the instigation of Prince Danneskjold Samsö a large glass-house was built in Holmegaard on Seeland which exists to this day. It arose near the immense peat deposits.

Another was established on the coast near the capital city, Copenhagen. That is the Kostrup glass-house founded in 1847. Further glass-houses were established in 1855 and 1873. But even today no sheet or bottle glass can be made in Denmark because, as in Sweden, there is no suitable sand and the country is forced to import all the other raw materials except chalk.

New Ideas in the Organization of Production

We may not forget to mention the division of labour which towards the end of the eighteenth century gradually developed in Northern Bohemia. The glass-houses, in fact, became real manufacturies, whereas the refineries continued in their former methods: cottage workers operating under a unified direction. The workers in or near one hamlet co-operated. They possessed their own tools and each had a decisive voice as to the details of the ornamentation. They were linked with the enterprise only by their orders, their raw materials and the personal relations of the people in charge. In certain villages only cutters were working, in others again only engravers or turners, etchers or silverers, glass painters etc. and in the centre (i. e. in Bor) there were the carriers. The glass-houses usually employed about one hundred people, the refineries linked an uncertain number of workers, including men, women and children.

The glass moved from one village to the next, and in each of these little centres its particular form of ornamentation was added. Only exceptionally outstanding and unafraid individual workers operated outside this framework, outside the guilds, independently. Let us, however, not forget that specialist refiners received their wages from one or another glass-house, but remained, in fact, independent masters.

Only after the introduction of machinery and of the mechanical implements in the second half of the nineteenth century did the order of this small world change. The glass products which to this turning point had been more or less the work of people's artists ceased to be so. Doubtlessly, the glass improved from a technical point of view as did the productivity, but the artistic side was almost entirely ignored for a long time.

That was the industrial deformation of the Bohemian artistic glass from which our glass industry began to recover only in our century.

I should like to draw the attention of the reader to the chapter which deals with a Bohemian glass-house in the nineteenth century. One paragraph describes how a worker in such an old glass-house became master. This explanation tells us the reasons why Czech names appeared only at such a late stage in the Bohemian glass-houses.

The master in a glass-house, producing "forest glass", was a master craftsman like all others. Although he worked on a piece rate, he remained the exploiter of the entire workshop which consisted of a few journeymen, assistants and apprentices. That was quite the normal set-up in the world of craftsmen at the time, at the stage of manufacture. It would in no way deserve our special attention.

The question is rather who could become the master of such a glass-house. Only a man who completed his training. And who could complete his training? Well, the journeyman.

And that is where the mistake creeps in: the assistant in a glass-house was not considered qualified in his craft and if he could not secure for himself a "workplace" near the furnace he could never be considered "qualified".

What here is called "qualified" must be understood in quite a different way: the three years' training could be undertaken only on the condition that the apprentice had secured a "workplace" near the furnace — through resignation or death of a master. This, again, was dependent on the expressed permission of the owner or tenant of the glass-house. But since no case is known of a glass-house master dying childless (usually the families had eight to twelve children) and since the earnings of such a master could not be reached in any other craft, that meant in practice that the workplace at the furnace was inherited by one of the sons, or at least by one of his relations. The same occurred when a glass-maker's family moved to a different glass-house since the majority of these families were interrelated to the Xth degree. A marriage into a different trade was considered as it were, indecent and, consequently, never happened.

It follows that only the son of a master or his nearest relative could become glass-house master and as such they formed a real aristocracy. Even today there are in Northern Bohemia children of glass-makers who could never become glass-house masters.

If we now read Thomas Lenk's complaint (1767) we understand the reality behind the fact that the foreigners had set up a bulwark for their descendents for centuries. They maintained, as it were, the material privileges of a nobility which survived even the collapse of the guilds; because "their" people were the owners of the majority of all the means of production and they had no intention of relinquishing the privileges they had acquired by custom. All others were only "proletarian assistants" whom they used if they could not fill all workplaces in the workshop with their own and the children of their nearest relatives. This sheds quite a new light on the fact that non-Czech names held their own for so long in the Bohemian glass-houses.

A BOHEMIAN GLASS-HOUSE DURING THE NINETEENTH CENTURY

Johann Rückel's Glass-House in Preitenštejn

GLASS-HOUSE MASTER FRANZ RÜCKEL described for us a West Bohemian glass-house which was founded in 1852 on the domain of Count Mensdorf-Pouilly, near the ruined castle Nečtiny. Its founder was Johann Rückel. The master worked there until his death eleven years later. His widow Anna continued the business energetically until 1896, when as a result of insufficient fuel she built for her son Adolf a modern generator glass-house in Kamenický Šenov to which the new master took all his previous employees. The Preitenštejn glass-house stood in the midst of a mighty, old forest. Its walls were made of hard sandstone; they were forty foot wide and ninety foot long and because they stood on a slope, the front was 25 metres high. The wood-work of the roof consisted of enormous tree trunks which had been hewn to a thickness of 16 in. These beams ran along the entire works, so that it seemed as if it was made of one piece. Even stronger supports had been placed crosswise and joined to them with collosal iron brackets. The double roof was made of shingle. When there was a storm the wood-work groaned and sometimes the workers were afraid they would be buried in their workshop by one of those old, soot-covered beams.

There were two furnaces in the glass-house, one — called the smaller — for seven and the larger for eight pots. They had been let into the ground in the old fashion; the ashpipe was 35 cm in diametre, above it were five grates of 25 cm wide, the three inner ones made of special fireproof sandstone and the two outer of fireclay with two layers of strong sandstone above it. In the middle of the furnace there was an elongated hole, along the side of which there stood a "wreath" which covered the fire and in front of which there stood the pots. In front of each pot a "workhole" opened which corresponded to each firehole. On the "wreath" there were eight rings, each of which had a horseshoe-shaped hole through which the glass could be taken out of the furnace. Above it there was the vaulted "crown" which was made of fireproof clay that had been mixed in the pot-drying room. A cross had to crown the top of the furnace. There was access to the furnace from the front and the back. The annealing furnace stood over the hole at the back and the glass could be placed into it from both sides; for this purpose specially wired earthenware pots had been prepared.

The fire from the furnace also heated the annealing furnace as well as the timber store-room above it, in which the wood was dried in five departments.

The size of the glass-house is indicated by the many things it sheltered under its roof: first the two furnaces, then a large room in which the glass was prepared; two rooms for the production and the drying of the pots and the store-room for them . . . Then there was a cutting room, a store for raw materials and yet another room for the finished products. A large waggon could drive right into the glass-house which for this purpose had two massive, two-winged doors.

The living quarters of the glass-makers were in a long building which, like the workshop, was made of sandstone slabs. It had nine corridors which ran from the front to the back and on each of these there were four "flats". Each flat owned a stable, a cellar, a piece of garden, meadows and a field, a timber allocation etc.

Production was dependent on the duration of the furnace. It rarely continued in action for a whole year. For during that period the heat wore the walls to such an extent that the furnace had to be re-built. Such a term was called a "heat".

In these old Bohemian timber-heated furnaces the melting period lasted much longer than today. When a full melt took 26 hours, the work period was divided into four "shifts". Such a "shift" lasted until the entire glass "batch" was taken out of the pots and used up and all essential preparations for the next "shift" had been completed.

The first "shift" began on Monday morning and finished at midnight. During this whole period there were only three half-hour intervals. The second "shift" began on Wednesday at 1 a. m. and finished in the evening of the same day. There were also the three short intervals. The third "shift" usually began on Thursday evening and finished on Friday towards midday. During this "shift" the rest pause was from midnight till 1:30 a. m. The little ones (from six years upwards) used this one and a half hour period for a short sleep in which they were often disturbed by the glass watchman; everybody slept around the furnace just where they found a spot to lie down. The awakening of the sleepers never passed without sad or funny incidents. The third "shift" was also shared by the women. They got up in the middle of the night, cooked strong, black coffee for their husbands and sons and their assistants and they took it to the workshop at three o'clock in the morning. The fourth "shift", finally, began on Saturday after lunch and finished on Sunday morning, again with the midnight interval and the long-anticipated black coffee.

These melts continued during the whole "heat" with only short intervals on the most important holidays or when it was necessary to change the pots. Six, eight and fourteen year old children took part in the day and night work. The smallest held the forms for the glass-makers; the bigger ones carried the ready-made glass that had been "cracked off" the punty on forks to the annealing furnace. A child that went on to this higher work was called "afterman" and was already considered a glass-house employee. If he was employed by a master to whom he held no family ties, he received wages: during the first "heat" 1 gl. 50 kr., later 2 gl. per week. A strange "afterman" received board and lodging from the master, for which a gulden weekly was deducted. (These are the wages of the seventies and eighties of the last century.)

If such an "afterman" wished to become a master himself he had to make great efforts. If he was a bright boy, he used every free moment to get near the fire. First he would try to take the glass out of the pots, and then blow it to a proper knob. Not rarely did a clever boy become assistant already at the age of thirteen years. That meant that he took on such jobs which were considered less important but demanded speed, care and skill. Strict discipline ruled and he often would feel the master's fists. As an assistant he earned 3 gl. 20 kr. weekly during the first "heat" and of this the firm paid the 20 kr., the master the rest. At the beginning of the next "heat" he received an increase until he earned 5 gl. 60 kr. per week which was considered the highest wage for an assistant.

He could earn extra by taking certain quantities of the ready ware to the yard — a job for which the master paid. He also "cracked off" the glass prepared for cutting with a glowing iron implement. Apart from his own work he had to do other precisely defined duties; he had to manufacture the various wooden implements which were used in the workshop and keep a few in store. Moreover it was his duty to find a certain quantity of resin and to store it, to cook it on the stove and press it in liquid stage through a thick cloth. This resin was used for moulding the earthenware forms. Such an assistent was not a glass-maker in the true sense.

As real apprentice a suitable boy could be accepted into the workshop only if a place at the furnace had been freed for him by the resignation or death of a master. For this the permission of the tenant or works owner had to be obtained. That was a remnant of feudalism, of the guild regulations of the past.

The time of apprenticeship was three years, but it was a form of training during which the apprentice already held the place of a master, even if with certain reservations and with a long list of different duties. It was most important for him to take care of his honour and his unstained reputation. He had to get permission in the glass-house office before he could go out to dance. He had to show respect for the masters and all glass-house employees. Smoking was unthinkable.

Apart from his work he had the following duties: heating the quartz — used instead of the glass sand — which the peasants brought in from great distances to the glass-house. For one hundred pounds they were paid eight to ten kreutzers.

The apprentices took the pebbles to the glass-house, cleaned the annealing furnace, filled it with quartz and raised them to a white heat by using hard tree stumps. Two hours before the beginning of each "shift" they took the quartz out of the annealing furnace, and threw it into a water container while it was still hot. That was the first, unpaid duty of an apprentice which he had to carry out two to three times a week. There was the danger that the hot steam escaping from the water container might deprive an unskilled apprentice of his eyesight.

His second task was waiting for him in the "pot room" on Tuesdays, Thursdays and on Saturday afternoons. The pots were usually made by an older master and the apprentices helped him to prepare the clay and to mould the pots; they made lids for the workholes of the furnaces, rings for the pots, plates and everything that was necessary for the work. They carried the ready pots to the kilns for baking.

When exchanging pots that had been destroyed in the heat of the fire they were responsible for the entire implements used during this process. The apprentices, who carried the pots on a slab which was suspended from a strong stick, submerged their bodies and hands in water in order not to suffer unnecessarily from the radiating heat.

After the completion of each "heat" they helped to take the furnace to pieces and assisted the stone masons to build a new one. All these gratuitous jobs had to be carried out throughout the whole period of apprenticeship.

The glass-house — as in former days — paid piece rate. The master glass-makers received their wages in the old fashion per "three-score". The value of the piece was agreed to in advance. In this way the price per "three-score" became stabilized, the master receiving 31.5 kr., an apprentice only 21.5 kr.

At the end of the three training years the apprentice was made master. The special ceremony always took place on Sunday afternoons. It was the duty of the glass-house publican to fill the cellars and larders with sausages, ham and wine as well as to provide the music. The entire staff of the glass-house formed up behind the band, first the two oldest masters who led the master-to-be, then came the entire procession in holiday clothes, in black suits and flat, black, silk caps, first the masters, then the journeymen and carriers and behind them the girls and the mothers with the children. To the sounds of a march the entire procession walked to the living quarters of the glass-house owner where the guests had assembled: the priest, the forester-in-chief, the game-keeper, the chaplain, the mayor and the higher magistrates. The new master had to provide two barrels of beer and supper for all in the ensuing feast.

The glass-makers were considered extremely well-paid craftsmen who had many other privileges. If the glass-worker had not already married as an assistant or an apprentice — which was usually the case — he aimed to set up house as soon as he became master. The bride was found among the daughters of the employees. Marriages between cousins were a common feature. Marriages between a glass-master and a girl from a family which had no connections with the trade were considered below their dignity and happened only rarely.

Each glass-maker's family had a small farm, a piece of land, meadows and a garden and one or two cows. They stored their own supplies of bread and wheat meal, their own milk, made their own butter, grew their own vegetables and potatoes.

The cash that the glass-maker earned financed all ordinary and extraordinary expenses. Each master received a deposit of 22 gl. every fortnight. On pay day the publican brought his "book" into the office—i.e. a 40 cm long slab of wood on which he had chalked up in wedges the master's consumption. The master himself had such a strip of wood hanging by his workhole. Every wedge meant one measure of beer consumed. The money for the butcher was also deducted in advance in the office. The master glass-maker had, of course, other duties. If he had a lot of children, as a rule very little remained after the annual calculations; there were, on the other hand, masters who saved annually a sum of 500 gulden, an enormous amount at the time.

The melting master was the most important master in the glass-house. He prepared the mixtures for the new "batch" and kept the necessary fragments for the "cullet" in boxes and baskets. Moreover, he kept also a supply of pressed fire clay for repairs. When the glass-makers left their workshop after a "shift" he began his job of cleaning the fireplaces and the chimneys whereby the stokers helped him. While the stoker lit the new fire in the furnace the melter tested the pots, changed their positions, if necessary, and patched up the many holes and bursts. He attended to the furnace in the same way. The melter filled the pots so that they were never more than one third full with the liquid mixture. As soon as this was molten, the melter stirred the content with aspen wood that had been soaked in water. After the first melt he would put in a second and a third. The fire was left to burn down a little, by not stoking it for half an hour. The glass was left to become a transparent liquid. Then the grate and the chimneys were cleaned and the fireplace was put in order and the clear glass mass was prepared in the pots for further treatment. Such a melt lasted 24 to 26 hours. The melters' wages amounted to ten gulden a week, plus living quarters and payment in kind.

There were usually two stokers. Heating was kept up from two sides and the stoker had to walk half way round the furnace for twelve hours to keep up the fire. As long as the melting continued his responsibilities were smaller since the real master of the furnace was the melter. But when the glass-makers took their places he was fully responsible, for the glass had to be kept at an even temperature. The stoker usually received weekly four, and later five gulden. When the work was finished it was his task to ladle the wood ash out of the bottom of the fireplace and to pile it up outside. He then took the ash to the "flux-burners" and received ten kreutzers per bushel from them. Wood cutting was another means of income for him. He was paid 20 kr. per cord.

The drying of the wood was the responsibility of the driers who supplied the stoker and were in constant charge of the wood supply. That was a dangerous job. All glass-house fires always started here. The stokers' weekly wages also ran from 4 to 5 gl. It was, moreover, their privilege to feed and water the animals that were constantly drawing waggons with raw materials into the glass-house, or collecting the finished goods.

The "flux-burner" who prepared the potash was a very special craftsman. The ash that came into his workshop was sieved, and mixed with a certain proportion of unslaked lime. This mixture then was placed into a tank with a double bottom. The inner bottom of the tank had small perforations and the water which was poured onto the mixture gradually filtered through these. In this way he gained the pure caustic potash solution. This was placed into a cauldron under which a fire was lit. The mass in the cauldron was left boiling until it changed into a hard, blue-grey mass which often had to be hacked out of the cauldron with great efforts. The "flux-burner" handed over this product to the melter who worked it further. In the cooling chambers the product was heated under constant stirring until it completely evaporated, leaving a sediment of pure, white powder potash (potassium hydroxide). For this very difficult work the "flux-burner" received only 4 gl. a week.

In each glass-house there was also a "stamper" whose "stamp-mill" stood on the stream. The water turned a wheel in an old log hut. To the wheel shaft a simple device was attached which raised a beam, the "stamp". Below it enormous quartz blocks were fixed with an iron ring, out of which a hollow had been chiselled which was then filled with the heated quartz that had been burst in the water. When the "stamp-mill" fell it hit this hollow and the pressure of the beam ground the contents into a fine powder. This, after sieving, formed the core of the glass "batch". Those workers were employed at the "stamp-mill" who usually carried the wood from the yard to the drying chamber.

The quartz set aside for grinding was taken by the workers out of the tank into which the apprentices had thrown it in a glowing condition. Here it was freed from all impurities and sorted very carefully into three kinds. This was the task of the glass-makers' wives who worked by the stream on large canvasses. The task was considered very important and highly responsible.

The perfect, snowy, white flints which did not show the least colour admixture formed the pure raw material for the best Bohemian crystal-glass with the magnificent silver lustre. This was used for the production of cut glass. It was called "extra".

The slightly coloured quartz gave white or "medium" glass. The third sort was the "common".

The stoker and the "stamper" were paid similarly; i.e. by bushel of sieved sand.

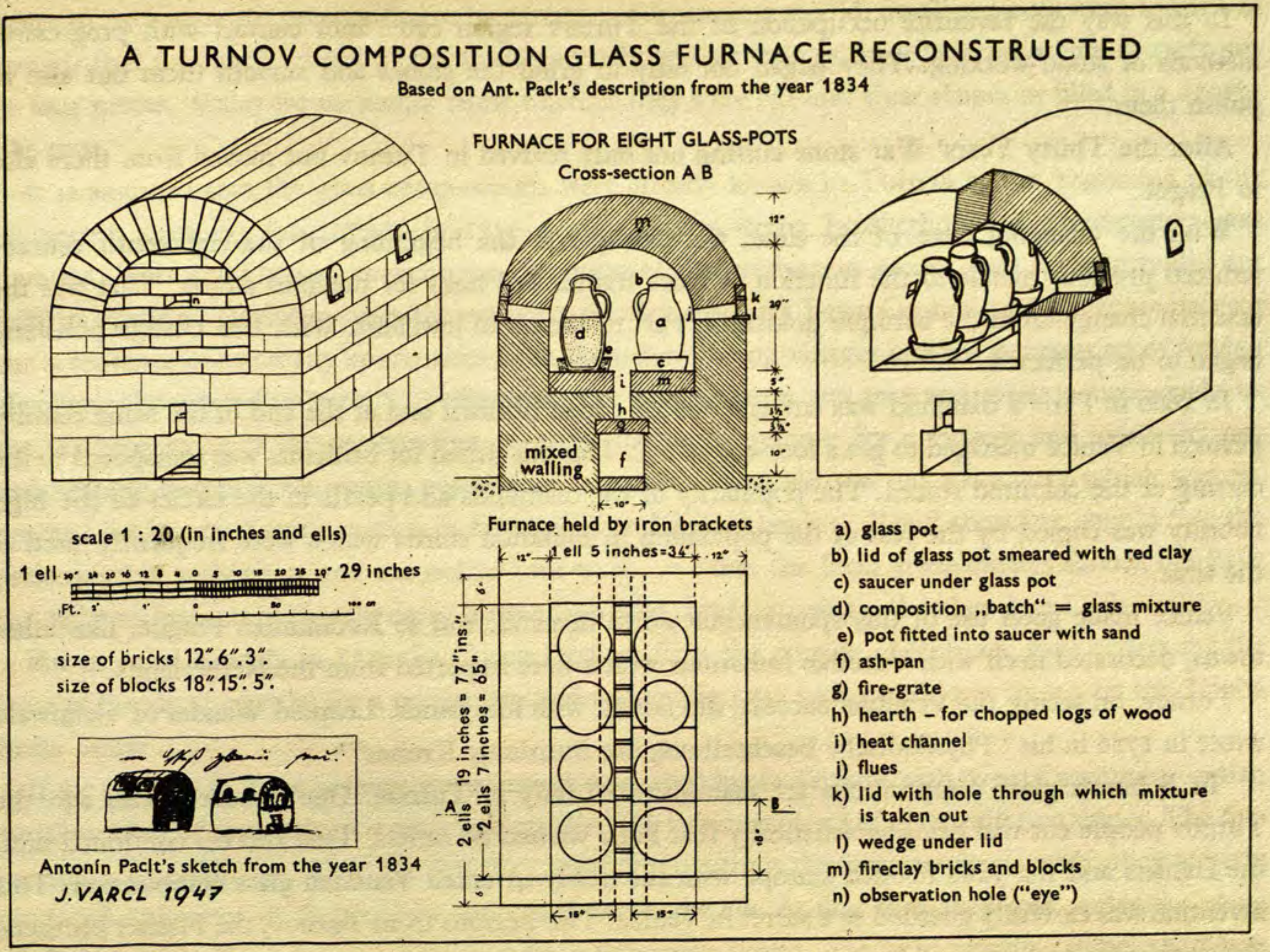
Finally we may not forget the "mould maker" who used to work together with the journeymen and the apprentices. He manufactured the most varied moulds from beech, pear and willow wood. He owned the furnishings of the workshop, obtaining his own wood for raw material and paying his assistants out of his own account. He received a percentage and the patterns remained his property. For the use he took a percentage that stood in a certain ratio to the wages of the masters and the market price.

At that time many clay moulds were used which the master glass-makers made themselves. Usually square glass was blown into them. Composed of several pieces these small earthenware moulds were small masterpieces which were carefully baked and artistically wired.

The metal forms were usually supplied by the large-scale refineries. They consisted of brass or cast iron. Later the fine relief moulds were made of pure nickel. They were extremely costly. We have already said that the clay moulds had to be lined with resin after each firing and before new use. Egermann says that the metal forms were dusted with flour.

The "glassmen", who year by year came to the glass-houses and sometimes waited weeks for the completion of the ordered goods, were usually Slovaks or Slovenes.

That, in short, is a survey of the glass production of an old Bohemian forest glass-house during the fourth quarter of the last century. It attests to the correctness of the various records which are preserved about the glass-houses of the last centuries, because the Preitenštejn glass-house represents a final point in the development of the old order of the Bohemian glass-makers.


A TURNOV COMPOSITION GLASS FURNACE RECONSTRUCTED
Based on Ant. Paclt's description from the year 1834
FURNACE FOR EIGHT GLASS-POTS
Cross-section A B
mixed walling
Furnace held by iron brackets
1 ell 5 inches=34"
2 ells 19 inches = 77" ins.
2 ells 7 inches = 65"
A
B
scale 1 : 20 (in inches and ells)
1 ell
29 inches
Ft.
size of bricks 12". 6". 3".
size of blocks 18". 15". 5".
Antonín Paclt's sketch from the year 1834
J. VARCL 1947
a) glass pot
b) lid of glass pot smeared with red clay
c) saucer under glass pot
d) composition „batch" = glass mixture
e) pot fitted into saucer with sand
f) ash-pan
g) fire-grate
h) hearth – for chopped logs of wood
i) heat channel
j) flues
k) lid with hole through which mixture is taken out
l) wedge under lid
m) fireclay bricks and blocks
n) observation hole ("eye")

145. A Turnov Composition Glass Furnace Reconstructed.

THE TURNOV STONE-CUTTERS ON "SOFT WORK"

THE INVENTION of the Bohemian crystal-glass is directly linked to the production of artificial jewels from glass. It deserves to be named in one breath with the art of the old cutters and polishers of precious and semi-precious stones. Already the so-called "Hájek Chronicle" from the year 1541 states the following about this art:

"The Prague cathedral was built with much trouble, diligence and expense. King Charles (IV) sent people searching for coloured stones in order to decorate the church or the St. Wenceslas Chapel with them. And at the foot of the Giant Mountains many large and hard stones of different deep colours were found which were called "jasper" and he ordered them to be polished and smoothed and the walls of the Chapel to be decorated with them."

Jiří Z. Varcl, in his most instructive study on this, the old folk art of the Turnov region (Kisa mixed Turnov and Trutnov), drew attention to this historical inter-connection. He relates that the preparations of the stones for the Prague Cathedral of St. Vitus were carried out by the court polishers and that especially in the sixteenth century — which we discussed in our chapter about Kaspar Lehmann and Rudolf II — this ancient skill was raised to a world level by the search for and mining of the precious stones. In the year 1601 Rudolf II granted the concession for the search for precious stones to the priest at Týn near Rovensko — the alchemist Simon Budecius.

In this way the favourite occupation of the Turnov region came into contact with progressive methods of stone working. They began not only to grind the stones and smooth them but also to polish them.

After the Thirty Years' War stone cutting not only revived in Turnov but moved from there also to Prague.

With the changing taste of the time, the baroque at the beginning of the eighteenth century reduced precious metals to the function of mere frames and links for precious stones. That was the essential change from the baroque goldsmith's art to the art of jewellers. With this change polishing began to be perfected.

In 1660 in Paris a diamond was cut as a double-edged brilliant and at the end of the same century Peruzzi in Venice managed to get a four-edged cut. This cut suited for brilliants was transposed to the cutting of the coloured stones. The popularity of the diamonds and pearls in the circles of the high nobility was copied by the rest of the population in imitation stones which were frequently used at the time.

Venice made good use of this spontaneous world demand. And so Rudolfinian Prague, like other towns, decorated itself with Venetian imitations which were imported from the Netherlands.

Turnov, on seeing the Venetian success, did not sit with idle hands. Leopold Wander of Grünwald wrote in 1786 in his "Physikalische Beschreibung des Bunzlauer Kreises"*:

"In Bohemia glass compositions are manufactured only in Turnov. One hundred years ago the Turnov people cut real gems so artistically that Paris wanted no others. That success continued until the Italians and the Jews flooded Europe with the newly invented Venetian glass composition. This invention was carefully guarded as a secret in Venice. Two persons from Turnov, the Fischer brothers, went to Venice and returned five years later in the belief that they had solved the secret. The work did not make progress but by constant trials they became acquainted with the material and by chance, in 1711, they made their first composition of sand, saltpetre and cinnabar with the addition of gold(?) with which they even surpassed the Venetians. These 'Bohemian brilliants' raised Turnov once again to its former heights. Two years ago (about 1784) a small piece of iron that had fallen into the incandescent mass caused the composition of the Bohemian garnet. Now there are three branches in Turnov: glass-makers, pressers and cutters. Merchants and customers from the whole of Europe gather here."

Trade inspector J. Schreyer wrote in 1790:

"Previously, the Turnov stone-cutters manufactured the composition stones either from glass pieces or powdered glass according to a prescribed method. After some time the brothers Wenceslas and Franz Fischer found a different way, namely composition by heating in a draught furnace where, according to demand, they made thick or thin sticks and from these they then pressed ten, fifteen or more stones with pliers. Each stone already had the proper facet since the iron mould was made in this way. Hereupon the individual stones were smoothed and polished on a copper wheel with emery or with rotten-stone. The stone-cutter now could produce more stones on one day than before in a week."

In 1927 an old workshop of this kind was discovered on a building site in Turnov. They found the most varying implements. The forms and stamps were made of brick clay. On one end of the stamp the upper half of the pattern was imprinted and the stamps had the size of the outline that was to be cut. The stamps themselves were made by being pressed onto a positive that had been made of clay which pressed itself into the surface of the stamp leaving a negative picture. For circular shapes (drops, pears etc.) an opposite process had to be carried out to attain a mould. Smaller pieces were formed in moulds that produced several pieces simultaneously and sometimes there was one stamp to each two or four pieces. Today we no longer know whether they were cut into their shapes or filled in a dough-like state.

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* "Physical Descriptions of the Ml. Boleslav District" (Transl. note).

It is assumed that the glass compositions were already known in Turnov at the beginning of the eighteenth century; for already in 1711 a numerically strong brotherhood of stone-cutters was founded. This guild was to prevent the alienation of the production secrets, but apparently did not fulfil its purpose. Twelve stone-cutters wrote to the Registrar and Town Council asking them to prevent the acceptance of too many apprentices from the neighbouring villages and the penetration of foreign elements who wanted to learn "... who do us the greatest harm and ruin and, what is more, make us the laughing stock of the surrounding domains, daring to practice for a modest and unworthy pay and heaping disgrace, therewith, not only on themselves but also on our town here which was renowned for its art of stone-cutting in far regions and distant lands ..." and therefore should "...the praiseworthy authorities and the police" see to it ... "that the local stone-cutters should not have the right to instruct in this art every peasant son who comes running or heathen Jew ..."

But in vain! Already in 1729 the Count Desfour from the domain of Rohozec gave orders for the issue of the standing rules for a similar brotherhood and in 1733 such a guild was set up on the Hrubá Skála estate ...

If we say that in 1715 seventy stone-cutters were working in Turnov with twenty assistants and an equal number of apprentices, it must be clear that they were producers of glass imitation stones. The former gem-cutters did not admit the fact that, apart from cutting the semi-precious jewels, they secretly produced imitations in their cellars and cut them on the sly. At that time they sold under the name of "Bohemian brilliants" green, blue and other Bohemian stones, just as in precious stones there was a distinction between Oriental and Bohemian garnets. In 1792 the revised guild rules do not mention the compositions and distinguish only two kinds of apprentices: " ... those doing hard work are to serve four years, those on soft work two years' apprenticeship ..." and only the initiated knew where they were.

But there were profits! And yet they did not last for ever, for after the Seven Years' War the tide of production turned, especially after the Vienna gold-maker Josef Strasser in 1760 introduced his new product with a strong lead content in Paris.

It deserves mention that most of the Turnov stone-cutters had a second occupation which was usually connected with fire, such as, baker, smith, soap-boiler etc. Only the family Paclt formed an exception here in being saddlers.

ANTON PACLT,

TURNOV STONE-CUTTER

Anton Paclt came from an old family of stone-cutters. Maximilian Paclt (1718—1798) taught his art to his grandnephew Josef Maximilian whose son Vincent, the famous world traveller, died as a prospector of the South African diamond fields. His brother Anton, born in 1800, left the inherited saddler's trade to devote himself entirely to stone-cutting. He worked for a time in Milan and in Venice, and in 1823 he became member of the guild. At the exhibitions in Vienna, London, Paris, New York and Munich he received awards. In 1845 he was melting the composition "batch" in five furnaces of his own, and he exported glass-ware to the value of 30 000 gl. His famous workshop stands to this day and shows us how the stone-cutters proceeded at their work.

The underground room was vaulted and in the vaulting there was a chimney that penetrated to the ground floor. In the room next to the chimney was the press where the glass was drawn into sticks. The composition furnace itself stood in the cellar. It is said that in 1827 in Turnov alone they made 450 cwt of composition glass; i. e. more than in Jablonec, Hodkovice and Rohozec together.

Paclt concerned himself with the sale of Bohemian garnets and other precious stones, especially Russian. He was in contact with Russia, France and America. He died in 1864 and left a recipe book with all necessary advice and instructions for the melting of the composition as well as detailed drawings and descriptions of his furnace.

This furnace was built in a rectangle and provided with a semi-circular crown. It contained six to eight pots, had a horizontal fireplace so that no real chimney was needed and the furnace could be placed on any protected spot, e. g. in a cellar or a rock cave and similar places. Clay was used as fireproof material. The glass was melted in jugs which were placed inside larger pots and were surrounded with sand so that in case of breakage the glass mass should not run into the furnace. The jugs themselves were brought from Saxony, Silesia and later all of them came from Zittau. The melting process is described in the following manner:

"After the jugs with the composition have been set in the furnace the latter is walled up except for the 'eye'. First, a fire is placed under the grate for six to seven hours. Only then do they begin to heat with wooden logs on the grate for a total period, including the warming, of twenty-seven to twenty-eight hours. But one should not count in hours, one should have a feeling when the jug is 'ripe' and whether the composition is sufficiently done. To test this a fresh, damp, thumb-thick willow rod is cut and put into the furnace; the rod flames up immediately so that the jugs can be well seen. If these do not shine as if they were polished or covered with a syrup, then the composition is not done enough.

I used to do it in this fashion: when the 'batch' was in the jugs I prepared a lid from a burst jug and covered it in red rotten-stone earth. When this began to run down I stopped firing and the composition was purified."

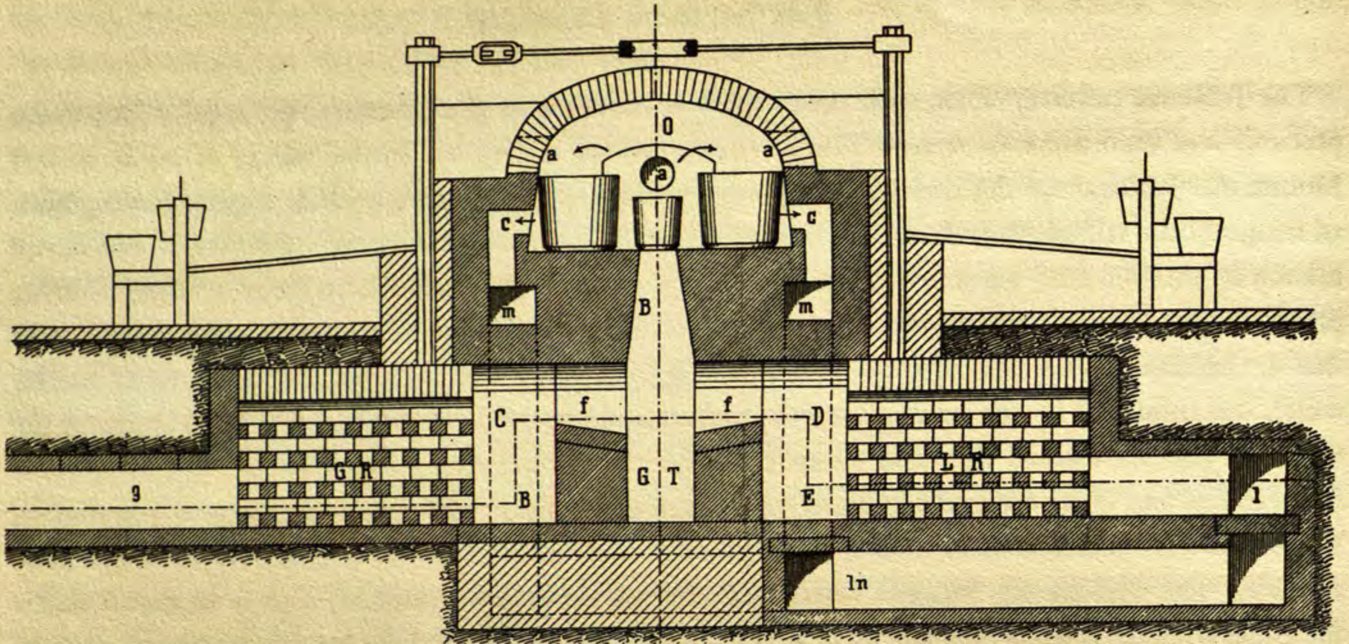
The "batch" consisted of burst and ground quartz which Paclt washed in a hydrochloric solution in a wooden tub. The alkalis were soda, potash and sometimes borax and saltpetre which served together with arsenic as a "fining agent". The divalent metal used by Paclt was lead which was added in the form of cinnabar. As a colouring agent he used manganese, gold, carbonated cupric oxide, cobalt oxide, iron oxide, chromoxide or even chromate. In order to prevent the composition from rising during melting he placed a little glass on top of the mass.

The dimensions of the furnace were 77 × 34 in. in the ground-plan, the furnace stones were 18 × 15 in. high. The lower section was constructed of varying building materials and the whole furnace was kept together by iron brackets. In the "crown" there were two pairs of flues that could be closed by sliding dampers. These dampers were supported on wedges so that a $^{1}/_{4}$ in. wide hole remained open. A 10 × 10 in. high and wide ash box ran horizontal with the heating channel along the entire length of the fireproof grate. The furnace was heated with thick logs. The liquid composition was left to cool in the jugs; these were then broken up and the glass mass was scraped off. The melted lump of glass was now crumbled up, melted anew and drawn out into sticks.

This old production method developed into the world-famous Jablonec glass industry.

The Jablonec industry arose with the purpose of imitating in glass the rare and popular Bohemian precious and semi-precious stones. The producers settled and spread in the valleys of the poor Iser Mountains. Jablonec on the river Nisa became the economic centre of the whole region. Having been an insignificant village, it grew within a short period to a township of 30 000 inhabitants. The entire branch of this industry assumed its name. It was a pure export trade where far more than in other places the fat years alternated with long periods of misery and hunger. A determining factor in this was the fashion and customs of the widely differing countries which it served. The quantity of articles which was produced by the small glass-ware makers and exported into the most distant corners of the earth ran into thousands. The lead composition-glass was made into beads, buttons, necklaces, beads for bracelets and other ornaments. Sticks and rods of glass of different colours served as raw materials. The beads were coloured and iridised. Their production alone used up to 900 tons of composition glass annually. The well-known "bangles" were made by cutting hollow cylinders. This is an export article for India where it is used by many sects as part of their ritual. Some of the beads were gilded, painted and polished.

The Jablonec industry has experienced various changes but the basic thought was always the imitation of precious stones. Even today "chatons" are produced which are deceptive copies of the most beautiful diamonds used in making ladies' brooches, necklaces, rings and bracelets. Over 1 200 factories in the environment of Jablonec concerned themselves exclusively with the setting of this artificial stone in metal. Jablonec gradually increased its sphere of work: an important branch was the crystal-glass section. Cottage workers produced objects for office use, table utensils, flacoons, plugs and other small articles of glass. Before the world economic crisis some 3 000 firms in this not very extensive district were fully employed on this production and 600 trade companies and 30 000 factory and cottage workers earned their living in this way.



146. Cross-section of a Siebert glass furnace.

HOW ARTISTIC GLASS IS PRODUCED TODAY

Written with the expert co-operation of Ing. Stanislav Bachtík, Professor at the Higher Technical School for Glass and Mining Chemistry at Nový Bor

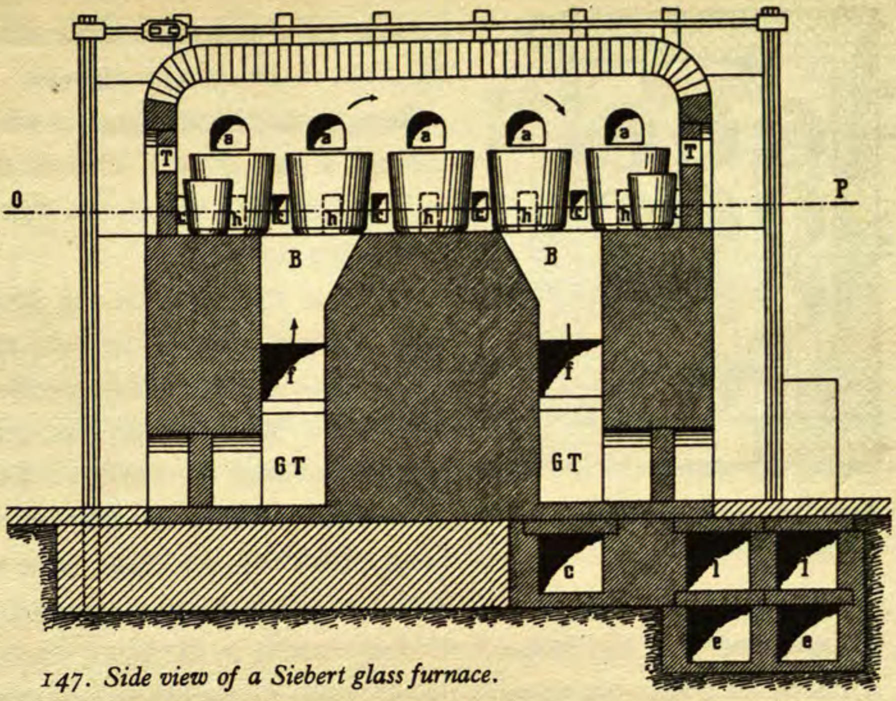
In the past the glass furnaces were heated by the direct flames of the burning wood, later coal, whose flames penetrated the grates and blazed right up to the pots in the furnace. It was proved that coal was a more profitable fuel since it produced a more even and greater heat and burnt longer. The disadvantage of this was that the flames carried fragments of ash and drops of tar which fell into the glass mass and there attached themselves to it.

A furnace heated with half-gas also disappointed expectations.

Today the glass furnace is heated exclusively with gas which either radiates out of the generators or, as in recent years in North Bohemia, comes from a distant supply of gas where by the turning of a valve the desired temperature can be developed in the furnace.

The old grate generators are dying out. Their place has been taken by generators with revolving grates. An even operation, high efficiency, cheap gas, clean work, mechanised servicing and the possibility of avoiding the heavy physical toil of the workers — all those advantages made these new installations highly recommendable even for smaller glass factories.

Today there are no difficulties in producing the fireproof materials for the building of a furnace in which artistic glass is melted. The meltability of glass can today be suited to all requirements, its chemical composition can be chosen in such a way that the glass melts at lower temperatures. For economic reasons the production of fireproof material, including the glass pots, have been centralized in special plants and the glass-works retain, as a last remnant of the former production, usually only the making of small furnace materials, such as, e. g., rings, lids, etc. It is self-understood that the production of artistic glass also shares the advantages of the rapid development of fireproof materials. The forms are made of iron, brass or nickel.



147. Side view of a Siebert glass furnace.

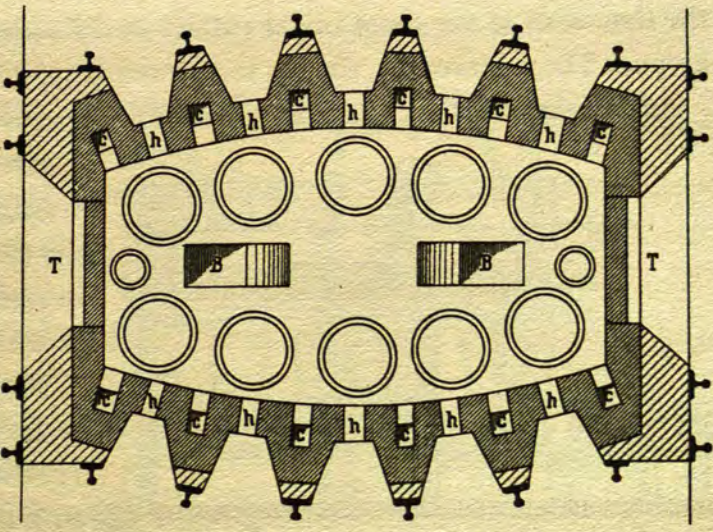
Glass-works have their own carpenter's shops. The modeller first receives a paper pattern or a drawing of a section with the data of thickness of the glass whereupon he makes, out of beech or even better pear wood, a negative of the glass vessel, of course, without bottom. If the form does not overhang the interior, it consists of one piece; but if it has a richly profiled cross-section, then it is made of two pieces, joined by an iron tape which for easier opening is provided with a wooden knob. Some especially complicated sections are even made in three parts. We spoke of beech or pear wood, because lime, sycamore and poplar show great gaps between the annual rings and would therefore not burn evenly.

The tops of forms which are composed of several sections usually are provided with little slabs which are to prevent the blown glass from overflowing. Gradually the inside of the forms burns out. Pieces for which an absolute precision of measurement is demanded have to be made with a correction, by the introduction of a wire which slows down the burning. One form suffices for up to one thousand pieces of thin-walled glass; but for only eighty to one hundred pieces with thick walls. Then it has to be regenerated, in any case cooled in the glass-works' pond.

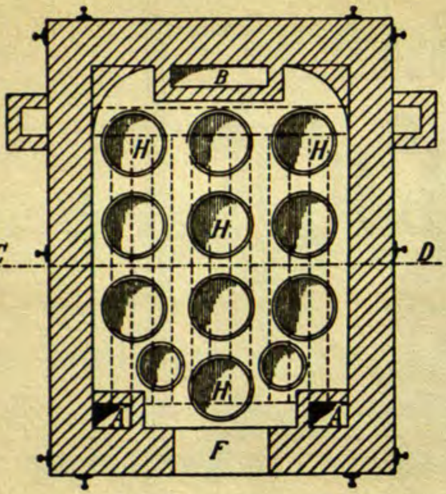
Metal forms are made of cast iron; they last an indefinite period of time but must be kept greased in order not to oxidize which would spoil the glass. Earthenware forms will be discussed later.

For the production of artistic glass preference is still given to pot furnaces. The melting of different sorts of artistic glass and especially the variegated palette of coloured glass is possible only in pot furnaces. That does not mean that the development of furnaces has remained behind for such special glasses. High-quality crystal is today also melted in tanks.

To make full use of the escaping heat the regenerative as well as the recuparative furnaces are used. For regenerative heating there are four chambers under the furnace linked together by an interchangeable switch device in such a way that through one chamber air and through the other gas flows into the furnace to warm up the heated chamber walls. Through the other two chambers the hot



148. Ground-plan of a Siebert glass furnace.



149. Pot furnace, ground-plan.

exhaust gases escape from the furnace. Usually every half hour the direction of the currents changes.

Recuperation installations, in which the exhaust gas flows constantly through a pair of flues, whereas the air that has been heated in the walls is directed through the other two pipes, are used particularly for smaller furnaces.

The pots are placed on the floor of the pot furnaces in front of the workholes. Under the pots are grates which enable the glass-maker to turn the pots if they should threaten to burst.

With his blowpipe the glass-maker gathers the glass mass from the pots through the workhole. Likewise the "batch" is placed into the furnace. During the melting process the holes are covered with lids so that the furnace loses none of its heat.

In our enterprises for the production of artistic glass usually Siebert furnaces are in use. The multi-flame furnaces are less frequent. During melting in the latter, a mixture of air and gas enters through a hole in the floor while through the other burner the exhaust gas flows back into the regenerators. The directions of the current alternate. This Siebert furnace has a conduit in the wall of the furnace into which openings lead in between which the pots are placed.

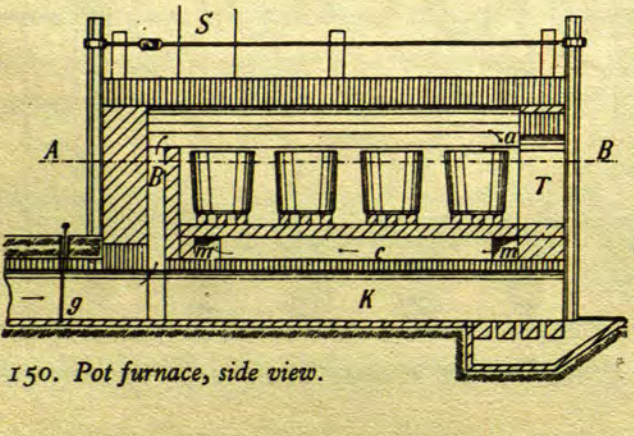
When the glass-makers are working the alternating switch is kept in such a way (in the middle) that gas and air enter the two burners at the same time and burn there whereas the exhaust gas escapes through those openings in between the pots into the conduit and from there into the chimney. This arrangement has proved itself during the work because the furnace is evenly heated at both ends whereby the entire oval-shaped furnace is kept at an even temperature.

The multi-flame furnace, on the other hand, has the advantage that the two pots, standing opposite each other, form one operating unit in the furnace. They can be heated without consideration for the neighbouring furnace to the right or left. Each pair of pots is separated by a wall in such a way that the two pots actually form a furnace of their own. When melting in such a furnace we need not adapt the "batch" to the regime of the entire furnace and can reach a different temperature in each individual section.

The uninstigated reader would probably be surprised on a visit to a glass factory that the furnace, at least the section that rises above the floor, is a comparatively low structure. The far greater part of the thousands of fire-proof bricks (which would suffice to build a medium-sized villa) is below the ground. The regenerators, the gas and air conduits, the flues — all lie deep underground.

At the height of about 50 cm around the furnace above the level of the floor of the furnace hall there is a two metre wide work podium. Here workers are crowding around the workholes. The work cycle on the furnace takes 24 hours and begins at 5 a. m. and in summer even at 4 a. m. to avoid the greatest heat of the day.

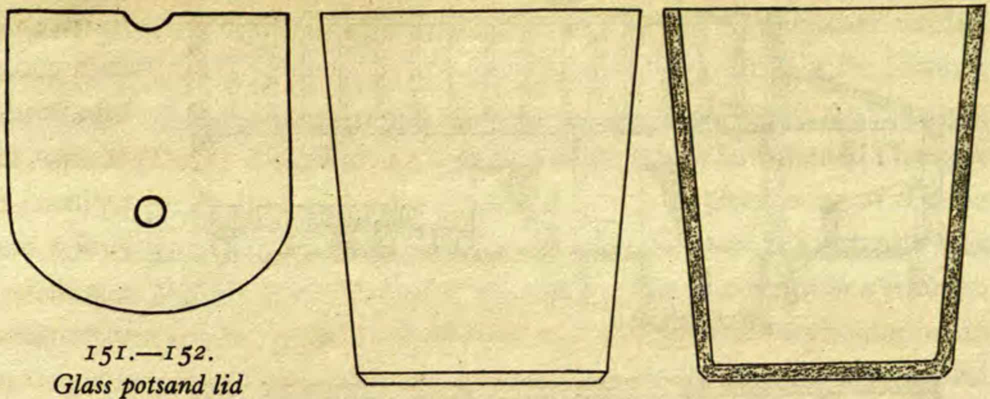
The motionless surface of the molten glass mass in the pots, cooled to a working temperature of about 1100° C. is set in motion when the worker "gathers" with the blowpipe. Hardly anything has changed on this age-old implement. It is still a steel tube about



150. Pot furnace, side view.

1.5 m. long with a 8—27 mm wide opening which is still by far the most important implement in glass-making.

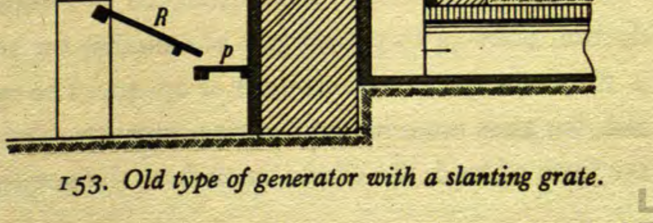
In the morning hours the smaller objects are made of the hot glass mass, because the mass is far too glowing and liquid to permit the removal of larger lumps. The work of the glass-maker differs from the preparation of every other material by the fact that the glass mass can be formed only during a certain strictly limited phase and that this short period has to be fully used by the master. In a fully staffed workshop glass-making is carried on in such a fashion that the mass goes from the knob-blower to the master via the hands of all qualified workers who with virtuosity form this glowing, rapidly cooling matter with their hand in — as it were — a loving way. The rapid congelation demands a quick and even tempo. From the small lump on the pipe the core of the future product develops. After it has cooled, the worker "gathers" a new lump onto the glass. This time the quantity is larger and so it goes on until the worker considers the quantity, needed for the production of the desired form and size, sufficient.


151.—152.
Glass potsand lid

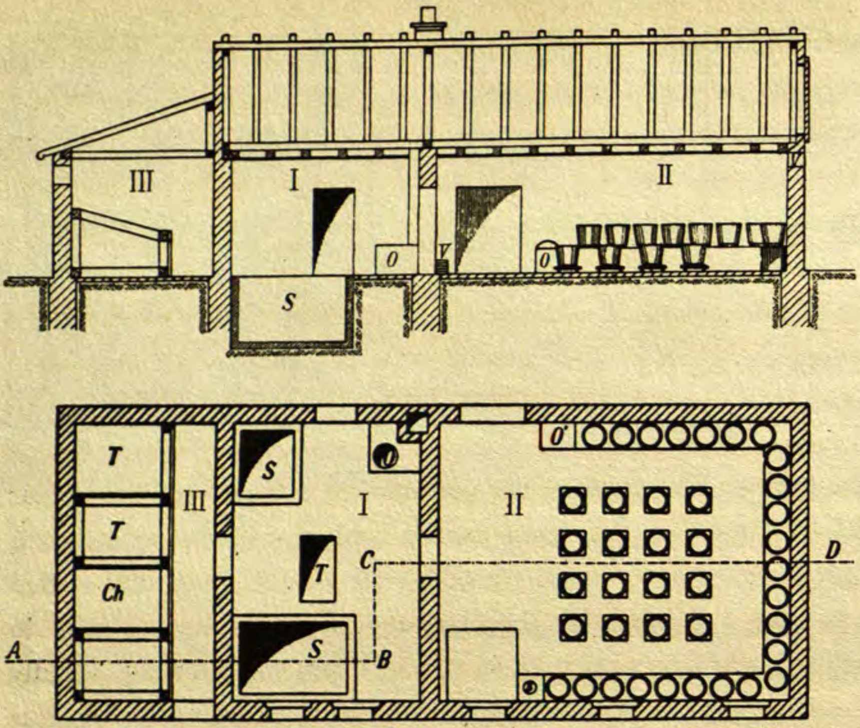
The simple lay-out of the workshop is conditioned by this rapidly cooling, viscous material. Everything centres around a small water-filled trough on legs. A lump of wood with different semi-circular notches and a wooden paddle serve as implements or rather as support during the process of shaping the glass. An iron fork is let into the trough on which the worker turns the blowpipe with the glass attached to it. Underneath is a tin basin to catch the drips or scrap. The glass-maker places the ready ware on a flat dish filled with sand. Further pieces of the inventory are a water tank and a form which the assistant holds while the master blows the glass. A piece of iron for "cracking off" the glass from the punty, glass shears, tongs for piercing and swinging and similar small implements complete nearly all the tools near the furnace.

The glass mass, having been given the desired shape with the wooden paddle, is now placed into the mould, the "model". By continued blowing under turning the object receives the circular shape and chiefly that perfect smoothness and a "fire-polished" surface.

The object, having been taken out of the form and cracked off, has not yet finished its journey. The carrier takes it with a fork and carries it to the annealing lehr. By rapid cooling of the surface (where the interior remains hot and its volume no longer keeps pace with the already cooling surface) there is dangerous stress and strain in the unevenly cooled layers of the glass. We speak of tension which causes that well-known cracking of the glass, which sometimes happens a short time after, and often after a longer period, yes, even after months. The glass is relieved of these strains in the annealing



153. Old type of generator with a slanting grate.



154.—155. Former pot furnace in an old glass-house: cross-section and ground-plan.

furnace where it is heated anew and then cooled gradually. The earlier, usually uneconomically working annealing furnaces today have been replaced by annealing installations with a moving belt; these are used especially in the production of artistic glass. The mysterious cooling (tempering) of the glass, previously dependent on the experiences of an older worker, is now carried out according to a precisely calculated annealing curve and feelings have given way to objectively working measures.

Such is the production process of a simple glass article. Complicated are those jobs where glass is stuck on, melted on, cut out, spread out and covered in layers. None of these jobs can be explained without simultaneous practical demonstration.

The production involves scrap. There is waste. Both are carefully sorted, for they form valuable raw material which is added to the next glass "batch".

After the end of the working period there is striking silence in the hall around the furnaces. The glassmakers take off their working clothes and, content with the completion of their beautiful task, return home to their families.

Around the furnace cleaning and sweeping starts, the finished objects are stored and a new shift comes on, the melters. During the work time the furnace cools down roughly to 1100^0 C. and now it has to be heated anew. The melters close the lids, open the air and gas supplies, regulate the outlet of the exhaust gas. We notice a little over-pressure in the furnace. Small flames begin to rise through the workholes — an indication that something is happening. After two hours the temperature rises to 1300^0 C. Near the furnace are the pots with the new "batch". This had been brought from the mixing halls where a change has taken place: instead of the old decimal we now see fully automatic scales. Hand mixing has given way to a mixing machine.

Two kinds of glass are melted: the Bohemian crystal-glass for whose production 100 kg of sand, 22 kg of potash, 12 kg of soda, 14 kg of lime from the Giant Mountains and a little saltpetre and arsenic are needed. The coloured glass for mass production takes 15 kg potash, 20 kg soda, 15 kg lime with saltpetre for each 100 kg sand. By the addition of manganese or selenium the colourless glass is "decolorized" i. e. the natural yellow or green tones are removed. This is based on years of practical experience.

The lead glass, which was introduced in Bohemia after the victorious advance of the English production takes 34 kg potash and 30 cinnabar for 100 kg sand. Coloured glass produced in our country is either transparent, translucent or opaque. The opaqueness is achieved by means of bone ash, fluorite and, for glass intended for lighting purposes, usually with cryolite (Na_3ALF_6). Silicic acid is added in the form of sand, the alkalis come from the potash.

When the melter reads on the pyrometer that the furnace has reached the temperature needed for the inserting of the "batch" he gradually removes the lids over the workholes and now the mixture is thrown into the pots with shovels. This charging is repeated since the "inflated" batch after melting with the chemical admixtures and after the escape of the rising gases decreases in volume. The heat in the furnace continues to rise and approaches 1450° C; the glass mass works, gases escape from the thick, muddy material. By "gathering" a lump of glass the melter tries to ascertain the degree of the melting. He wants to know if the sand has already melted and if the glass is penetrated with fine bubbles. Now the decisive moment has arrived, i. e. the glass has to be freed of the bubbles and its homogeneity has to be eased by stirring. For this purpose the melter once again takes off the lid, and with a steel rod he dips a piece of wood that has been soaked in water into the bottom of the pots with the glass mass and stirs it energetically. The wet wood gives off a lot of steam which rises in great bubbles from the bottom of the pot and on its way takes with it all the little bubbles, thereby perfectly mixing the mass. That is the "purification". After this "sacred" act the actual melting is completed. The melter now has to convince himself of the good quality and perfect purity of the glowing mass. His job is done. He now merely approaches the furnace to cut off the supply of gas and air so that the temperature might sink and the glass mass might gradually reach the working temperature. Morning dawns. The melter has completed his task.

In front of our eyes five thousand years of the glass-maker's work have passed. Much, much has changed. The contemporary production of artistic glass has developed from the minute corals and beads which once decorated men who lived unimaginably long ago — of whom we have but dim knowledge. We picture to ourselves the master glass-maker who learnt to improve his magnificent glass as it came to him from the works in a raw condition. In the course of centuries he learnt to cut it, to polish, to grind, to paint it and other such methods of embellishment so that glass may serve all men.

We shall never forget that it was by way of those beads that we reached our mass production of technical glass without which our changeful, multiform, progressive life would be unthinkable . . .

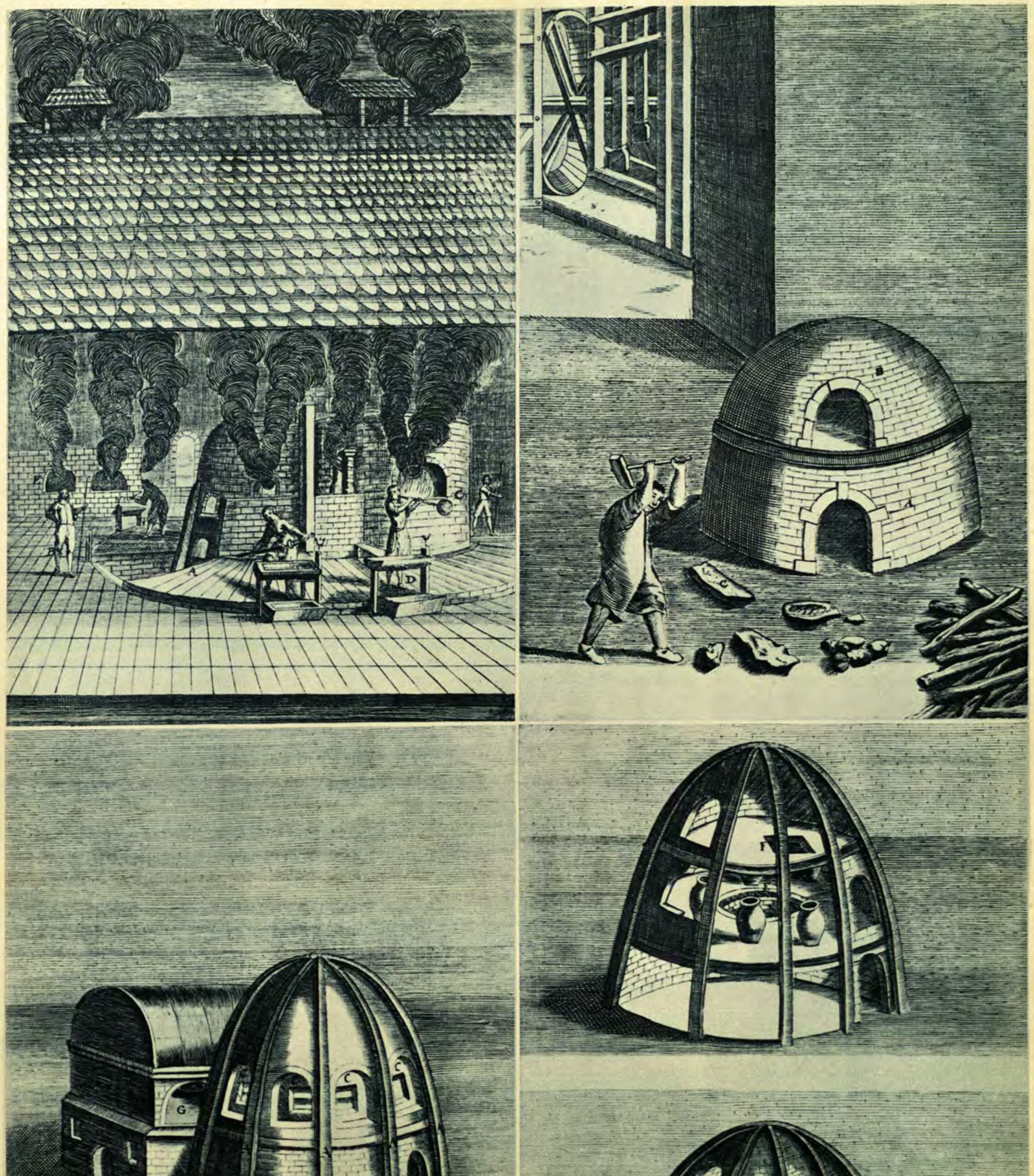
In the place of the small pit in the ground, in which the first glass was born, in the place of the old, transportable, shingle-covered forest glass-houses and the narrow rooms we have today the gigantic dimensions of the vaulted work halls of the large enterprises. And as we are abolishing the exploitation of man by man we are replacing here, too, the toilsome work of the glass-makers by machines.

We are building a new, a socialist order. It opens new perspectives to the glass artist who knows that it is his task to create beautiful glass with the help of all the achievements which technique and science can offer to the working people in the new, higher social order. This glass shall eagerly compete with the epic of a great poet who sings of the glory and heroism of Man in this new era of history.

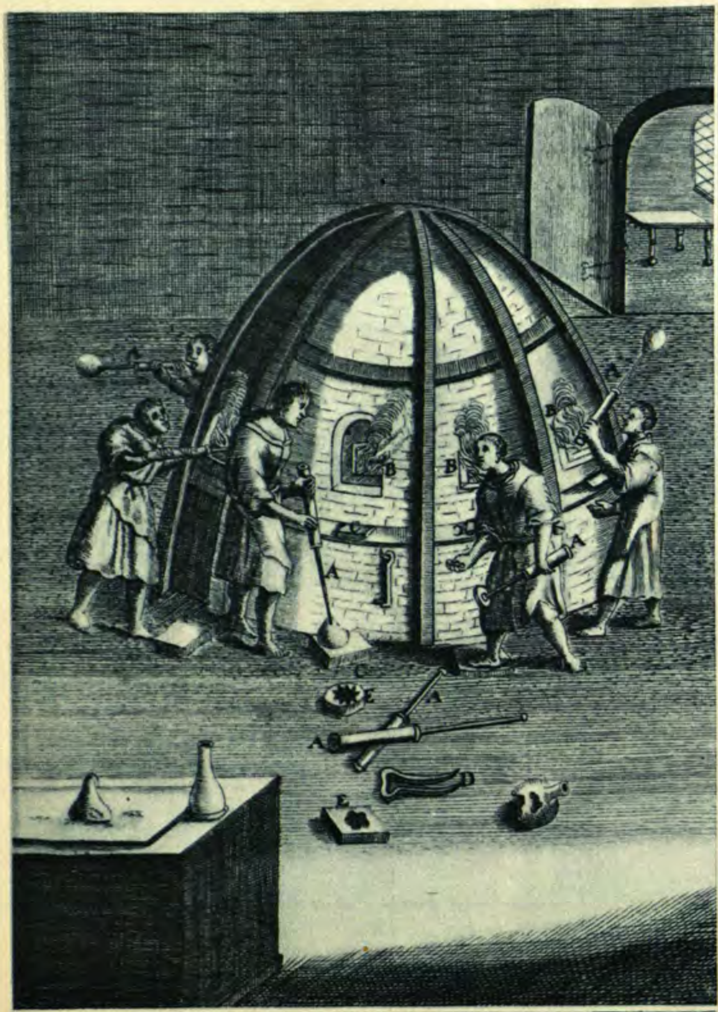
The smooth, shining surface of the glass purified in the heat of the fire speaks to us of its five thousand year old development.

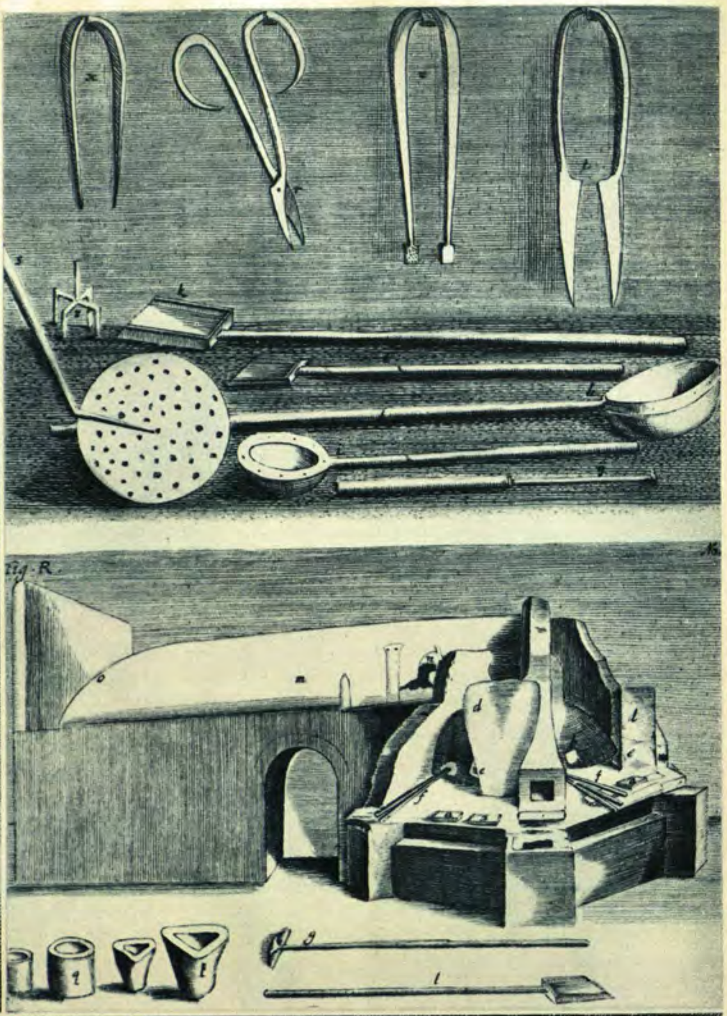
Look at its brilliant future!

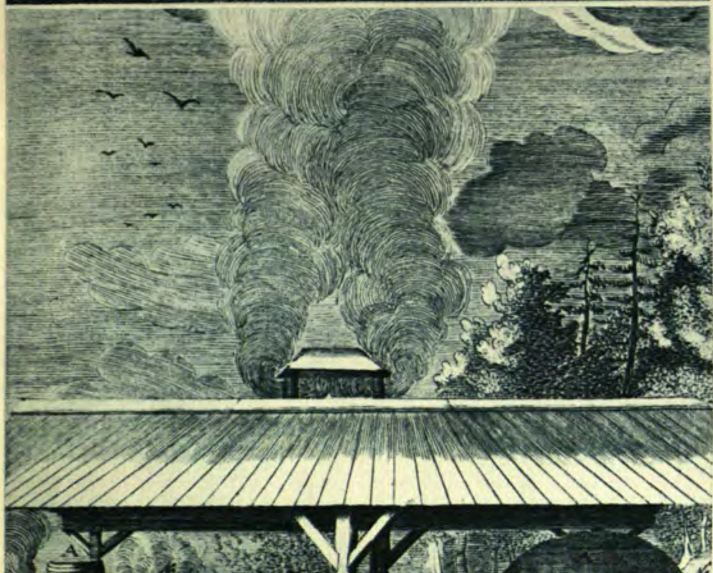
ILLUSTRATIONS

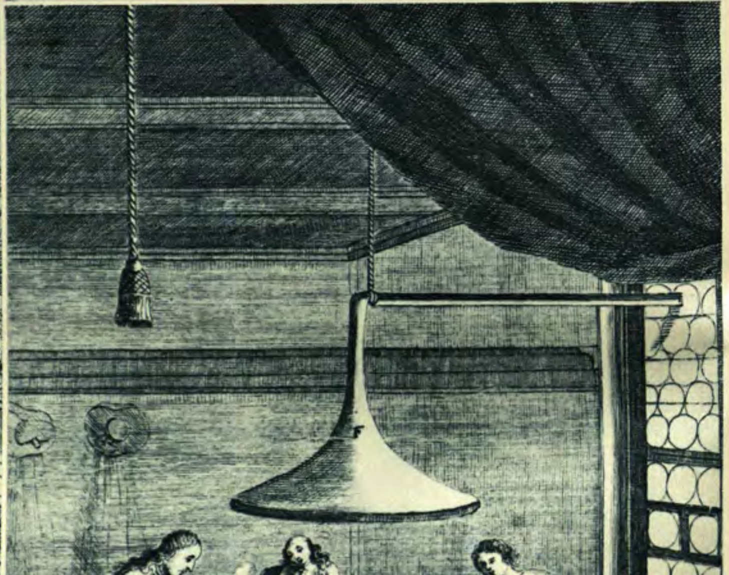


1. Work in a Glass-House (After a Copper-Engraving in Kunckel's Work, 1689). 2. The Glass-Maker Breaks up Raw Glass; in the Background the Stamp-Mill. 3. Old Glass-Furnaces, Old Pots, Old Forms. 4. The Inside of a Glass Furnace and the Outside with the Work-Holes.

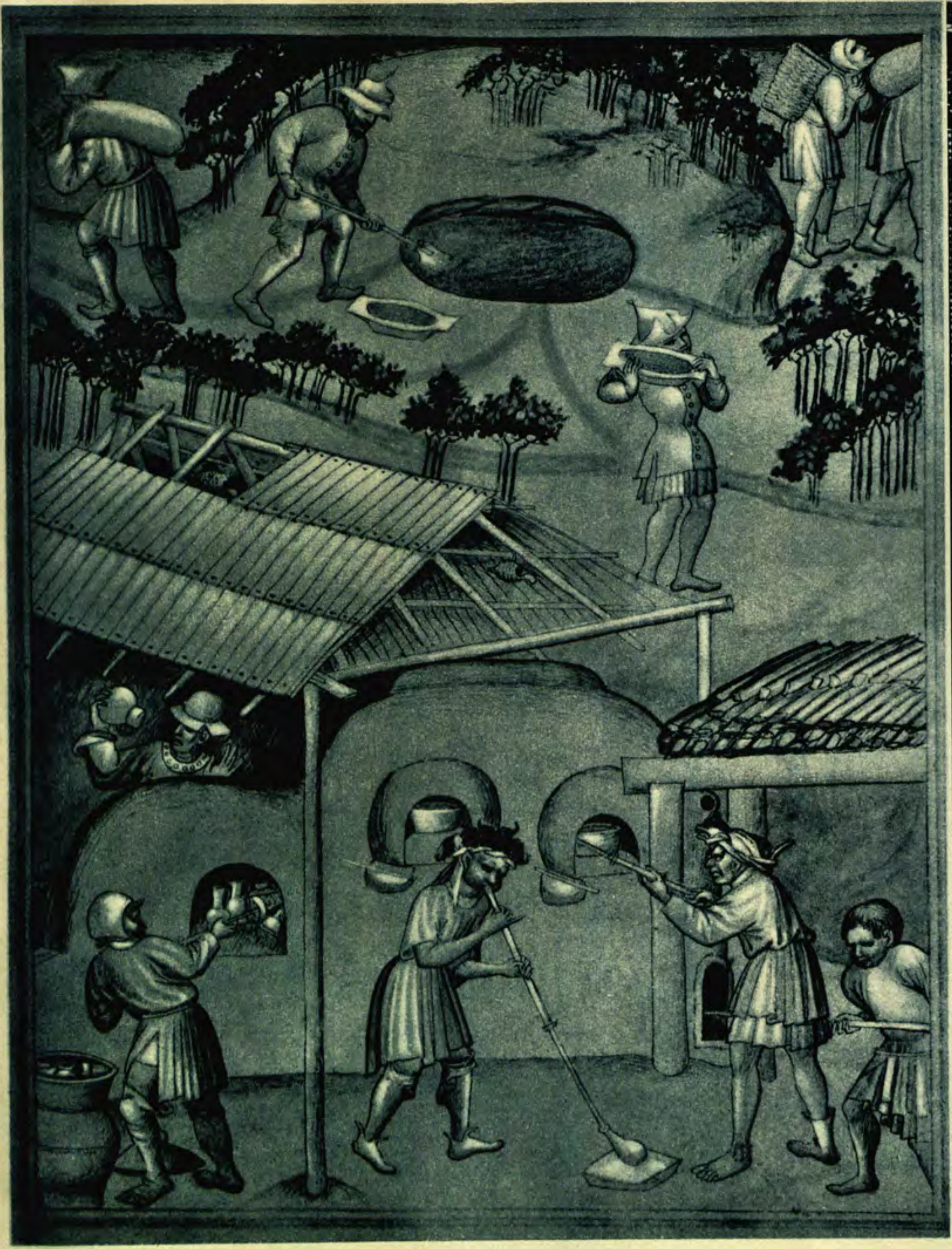




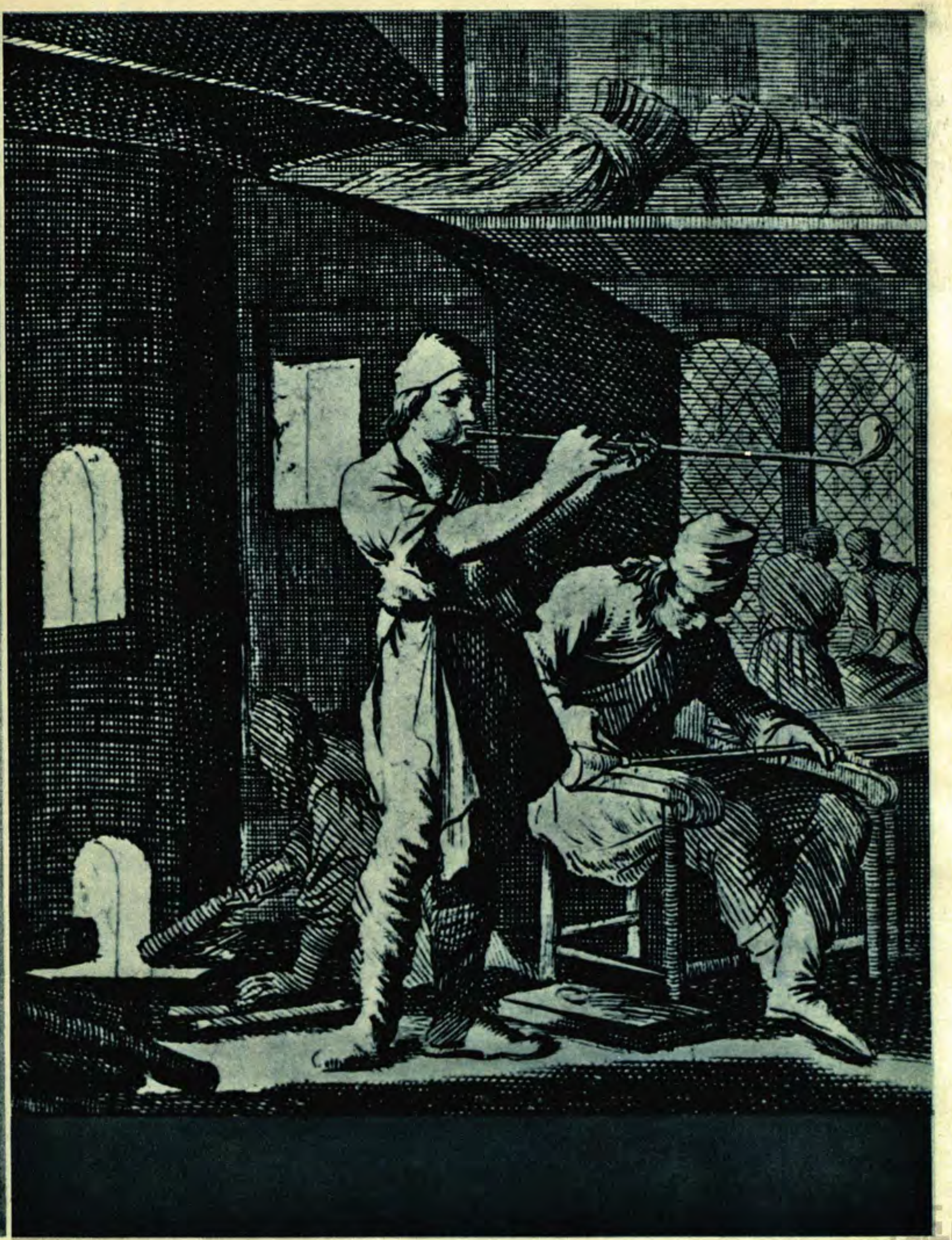




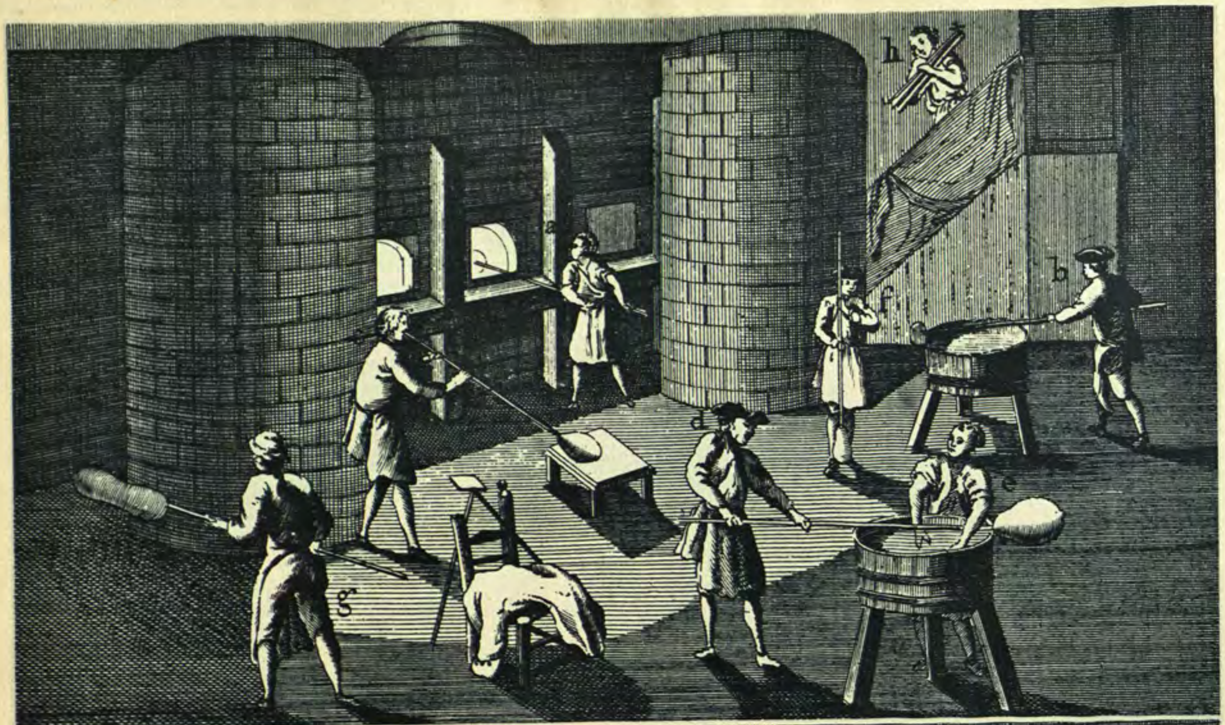
5. The Work of the Glass-Blowers around the Glass Furnace, their Blowpipes and the Forms in Front of Them on the Floor. 6. Implements and the Inside of an Old Glass Furnace. 7. Furnaces for the Production of the Additional Raw Materials for Glass-Making. 8. Making Glass Beads over Primitive Lamps; End of the 17th Century. (All Copper-Engravings 1—8 come from Kunckel's Work; one Section is Taken from Agricola.)



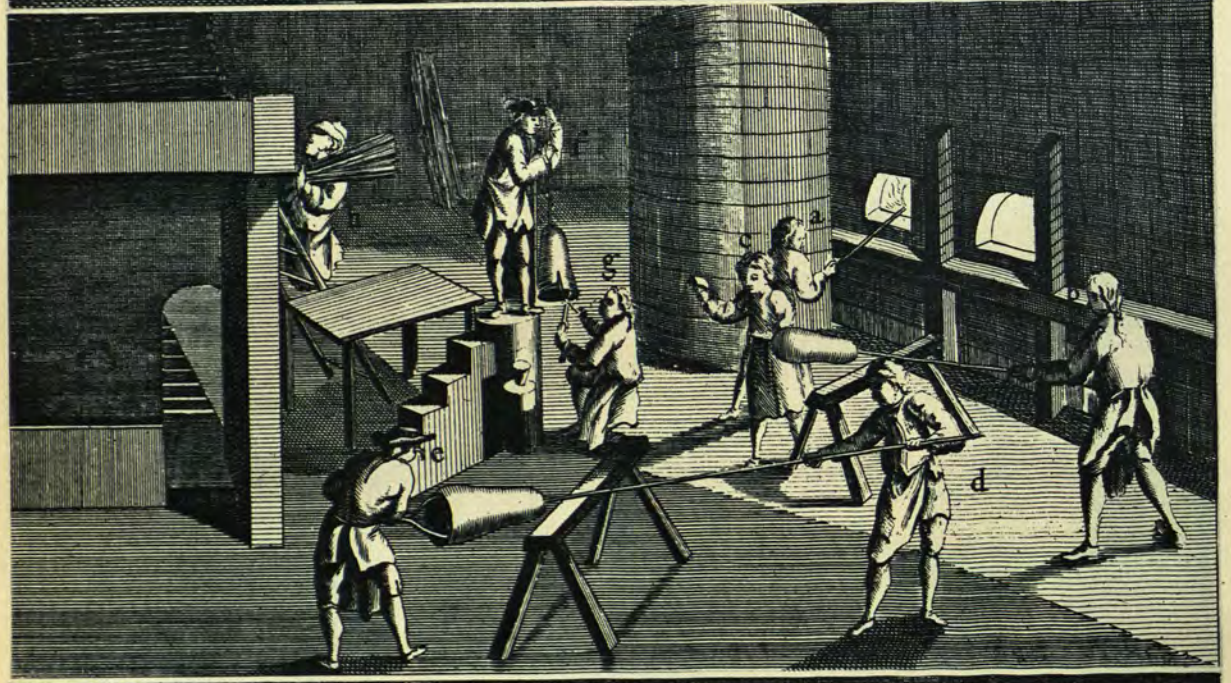
9. *A Flemish Miniature: Glass-Makers in a Glass-House in the 15th Century.*



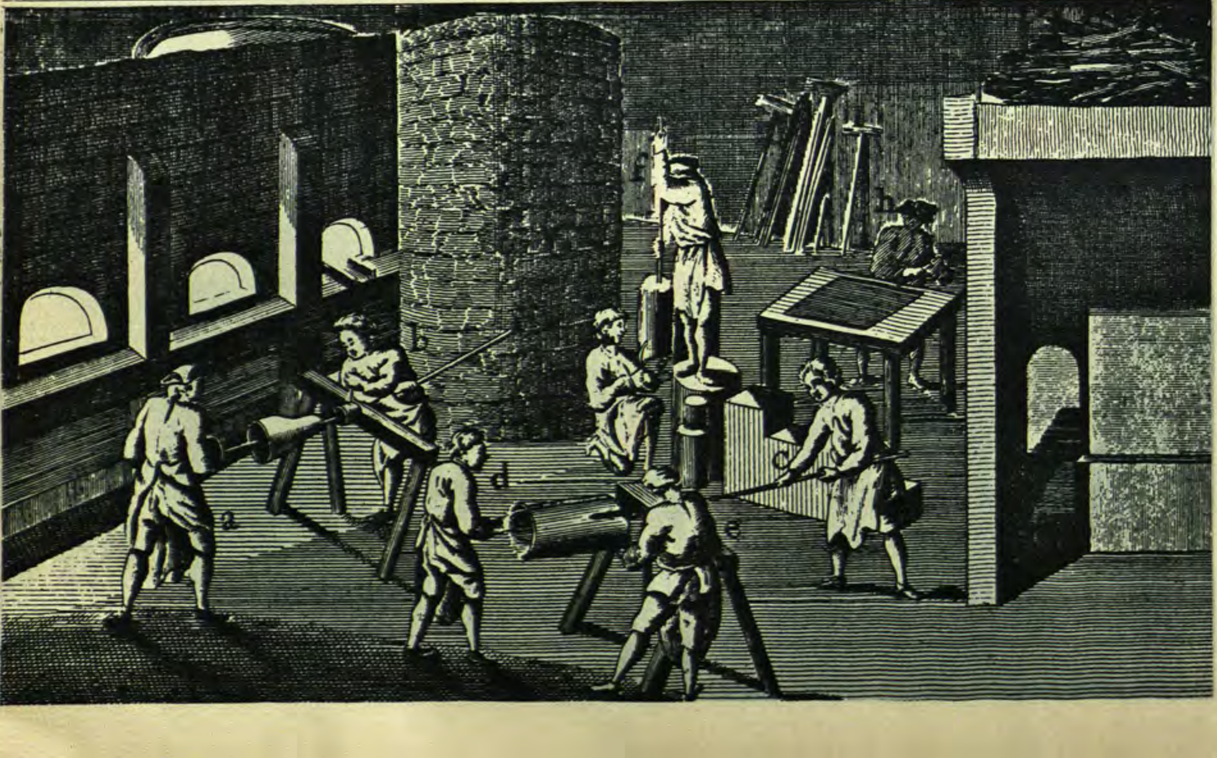
10. *In a Dutch Glass-House During the Second Half of the 17th Century. (Copper-Engraving from the Work by Abraham a Santa Clara.)*



11. The Blown Glass-Cylinder Begins to Take Shape.

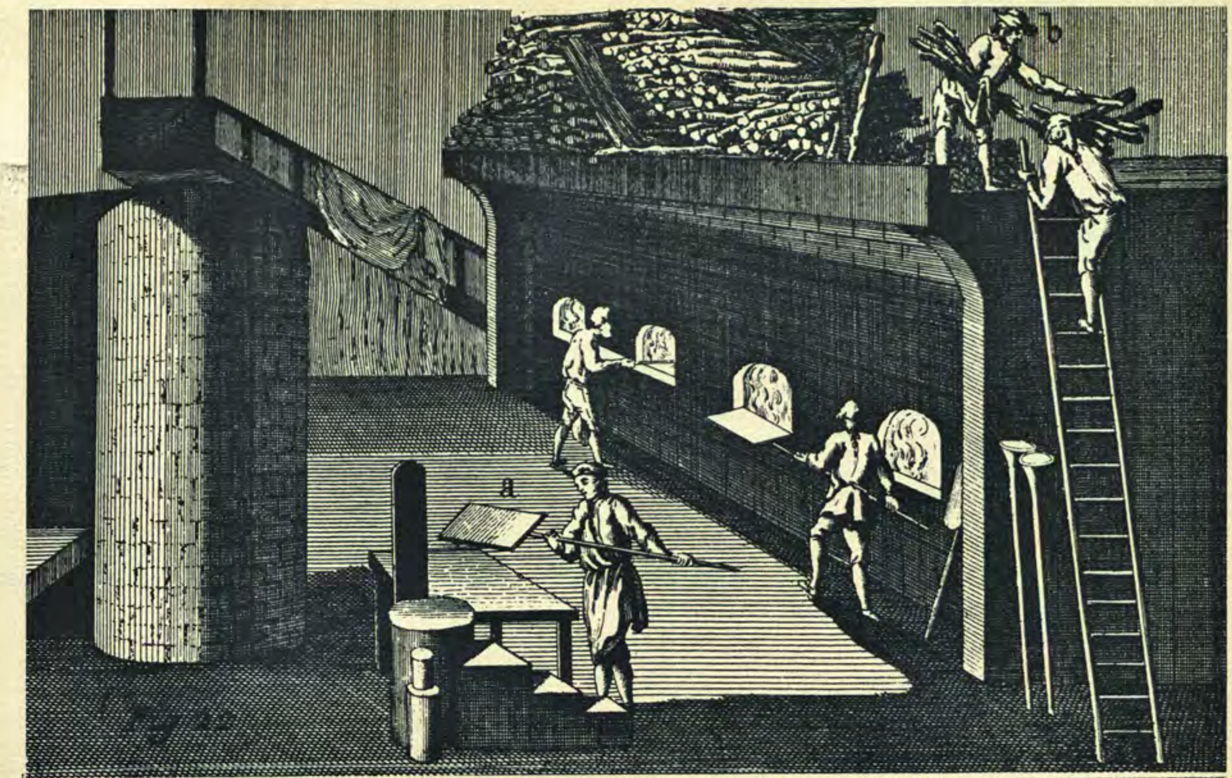


12. Further Work on the Glass Cylinder.

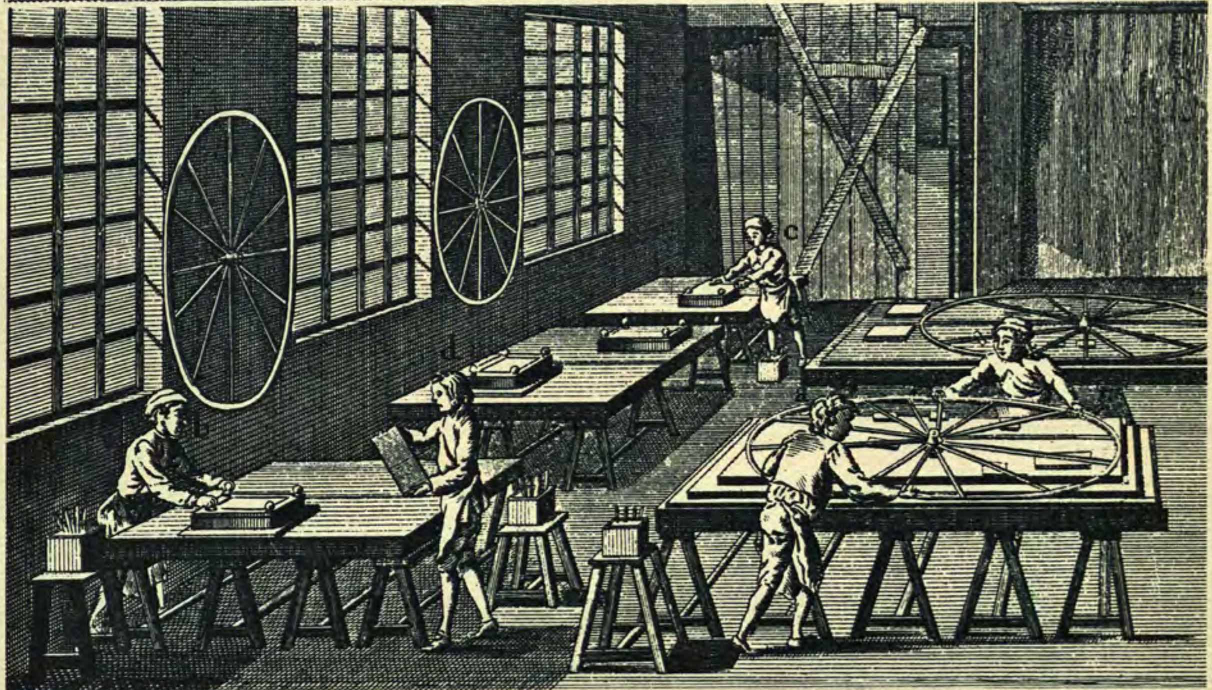


13. The Glass Cylinder is Rolled in the Production of Flat Glass.

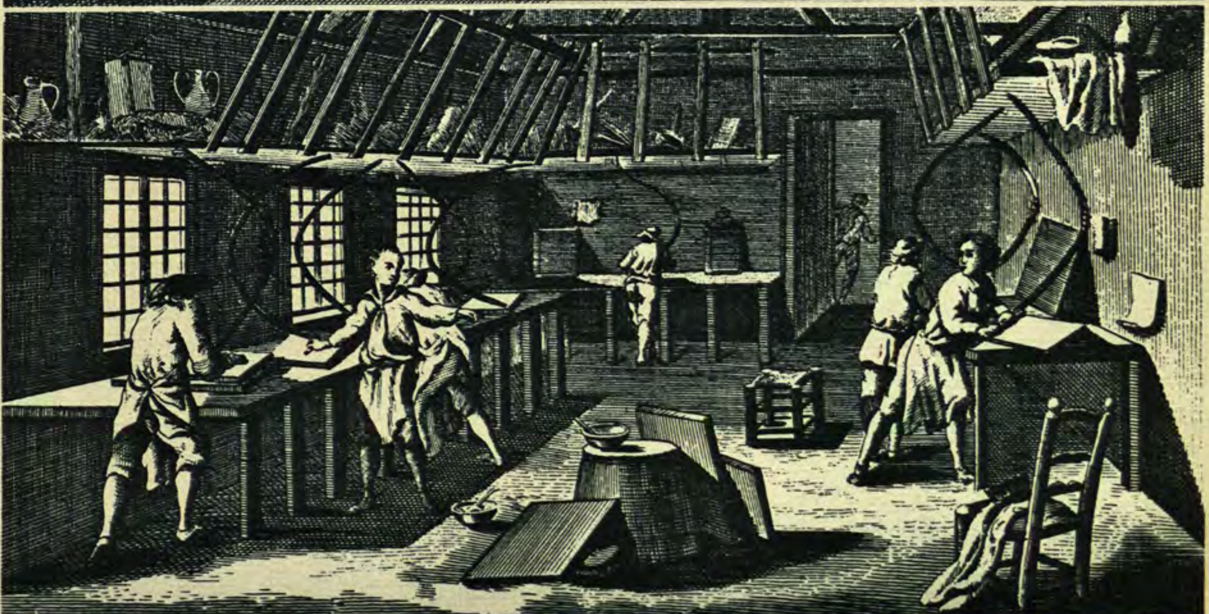
14. The Final Shaping of Glass Sheets in the Furnace.

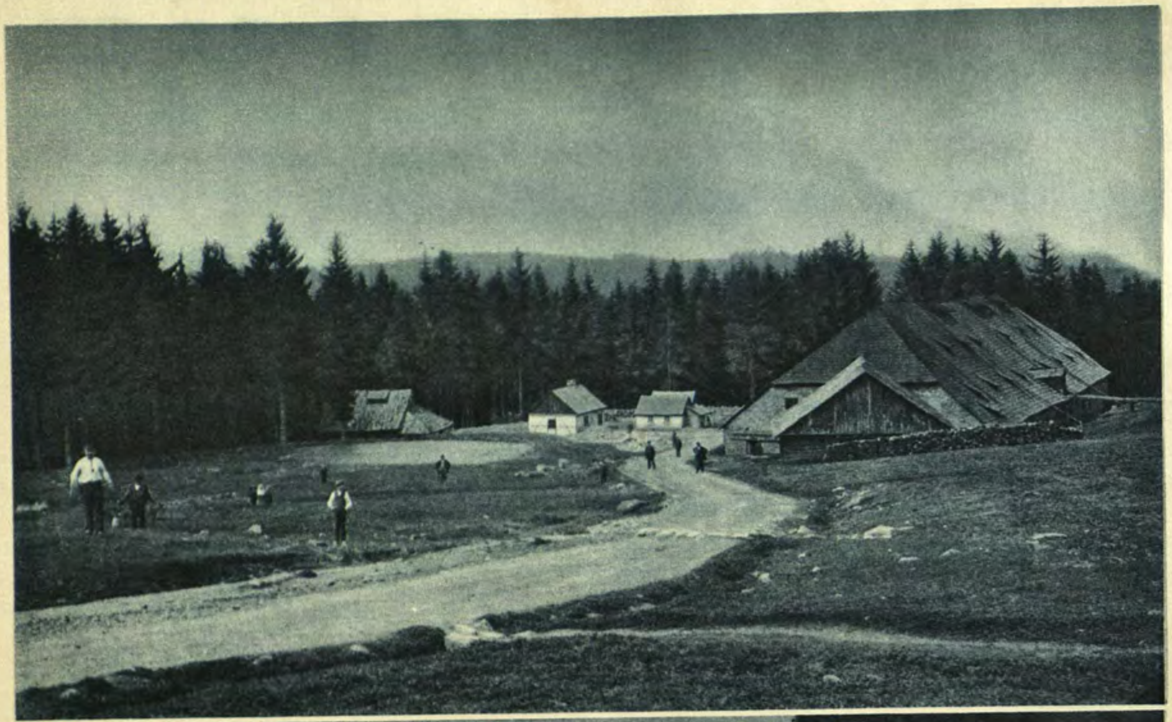


15. Mirror-Glass is Ground.

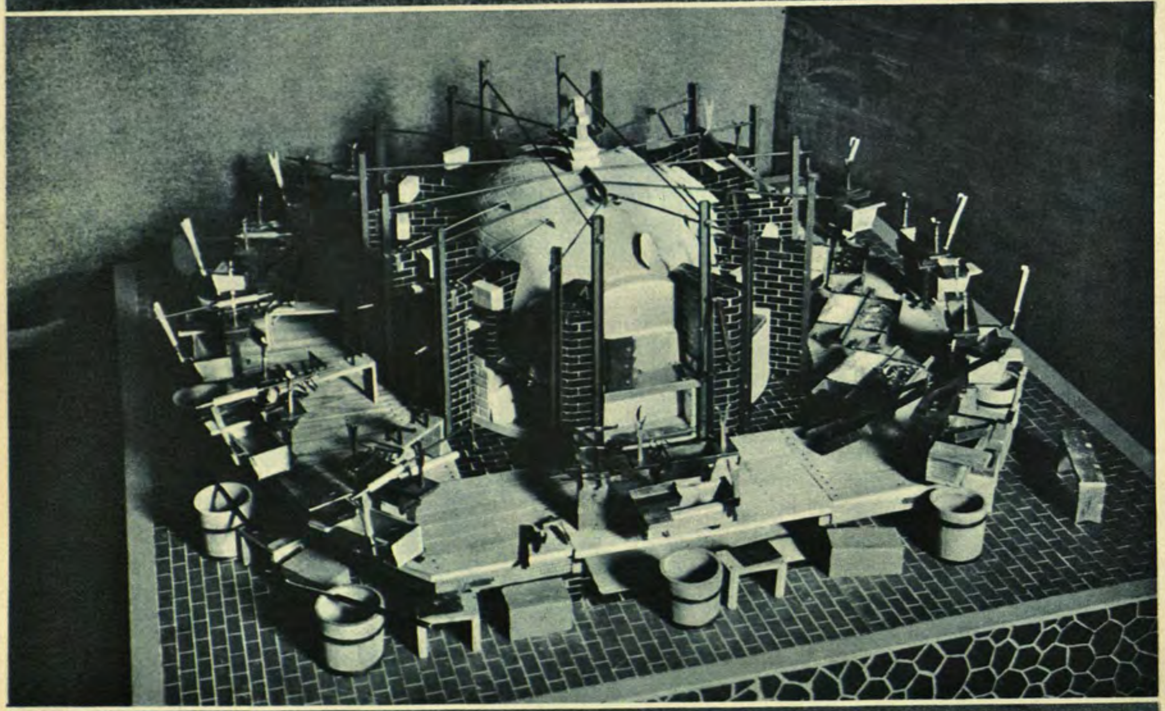


16. The Final Polish of Mirror-Glass. (The 18th century process of producing mirror-glass by moulding and blowing. Copper-engravings from the contemporary work "Verrerie en glace ou manufacture des glaces".)

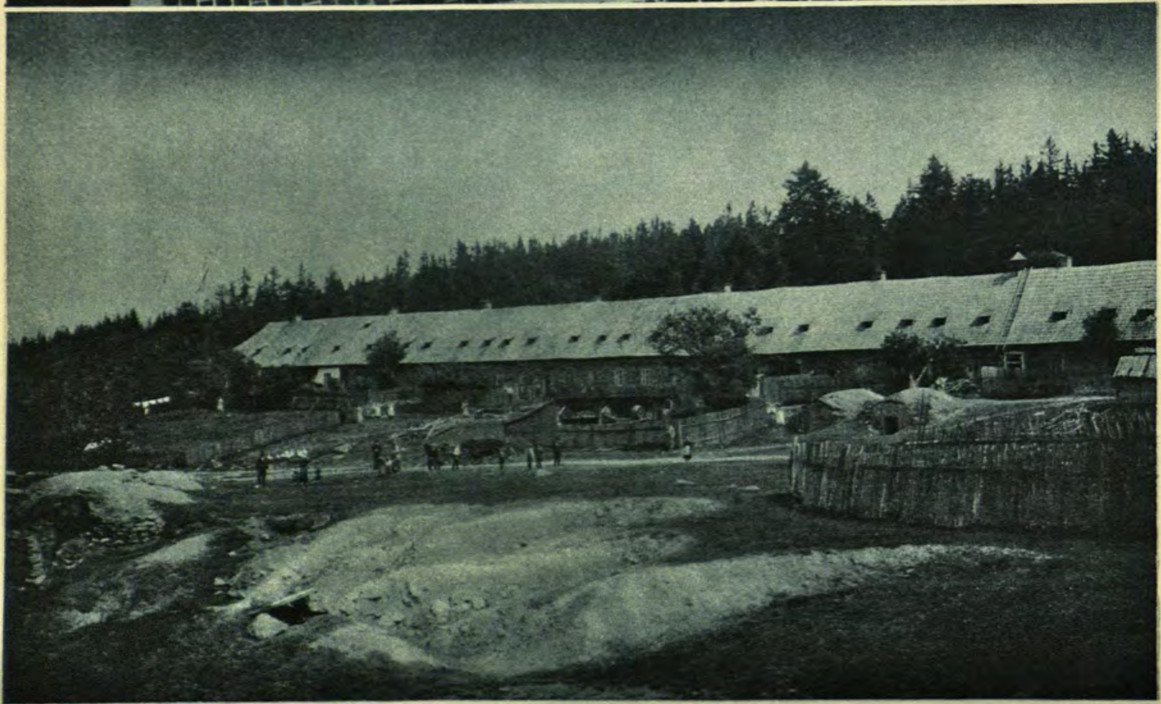




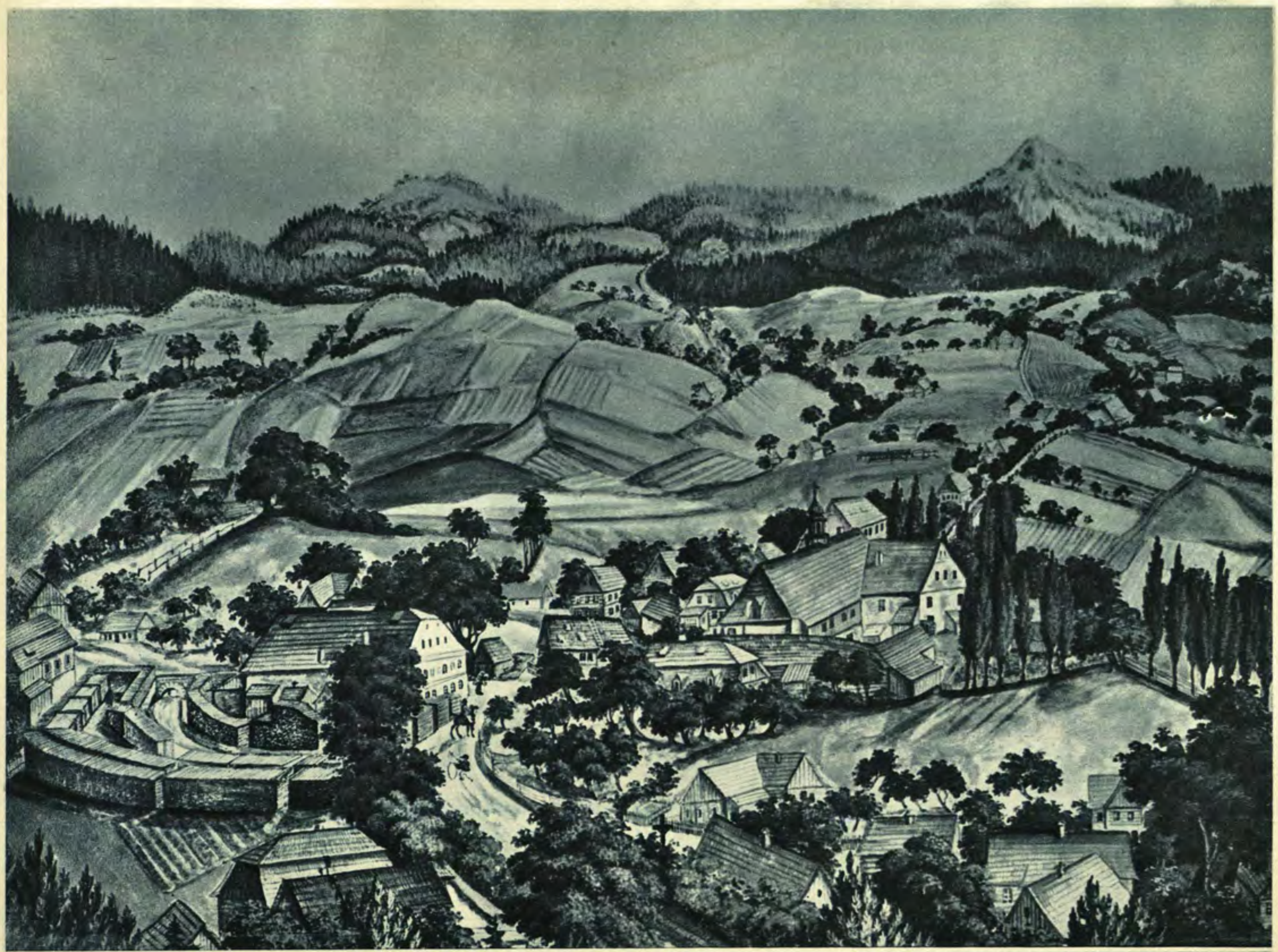
17. *The Bohemian Glass House in Breitenstein Shortly Before it Closed Down. (End of the 19th Cent.)*

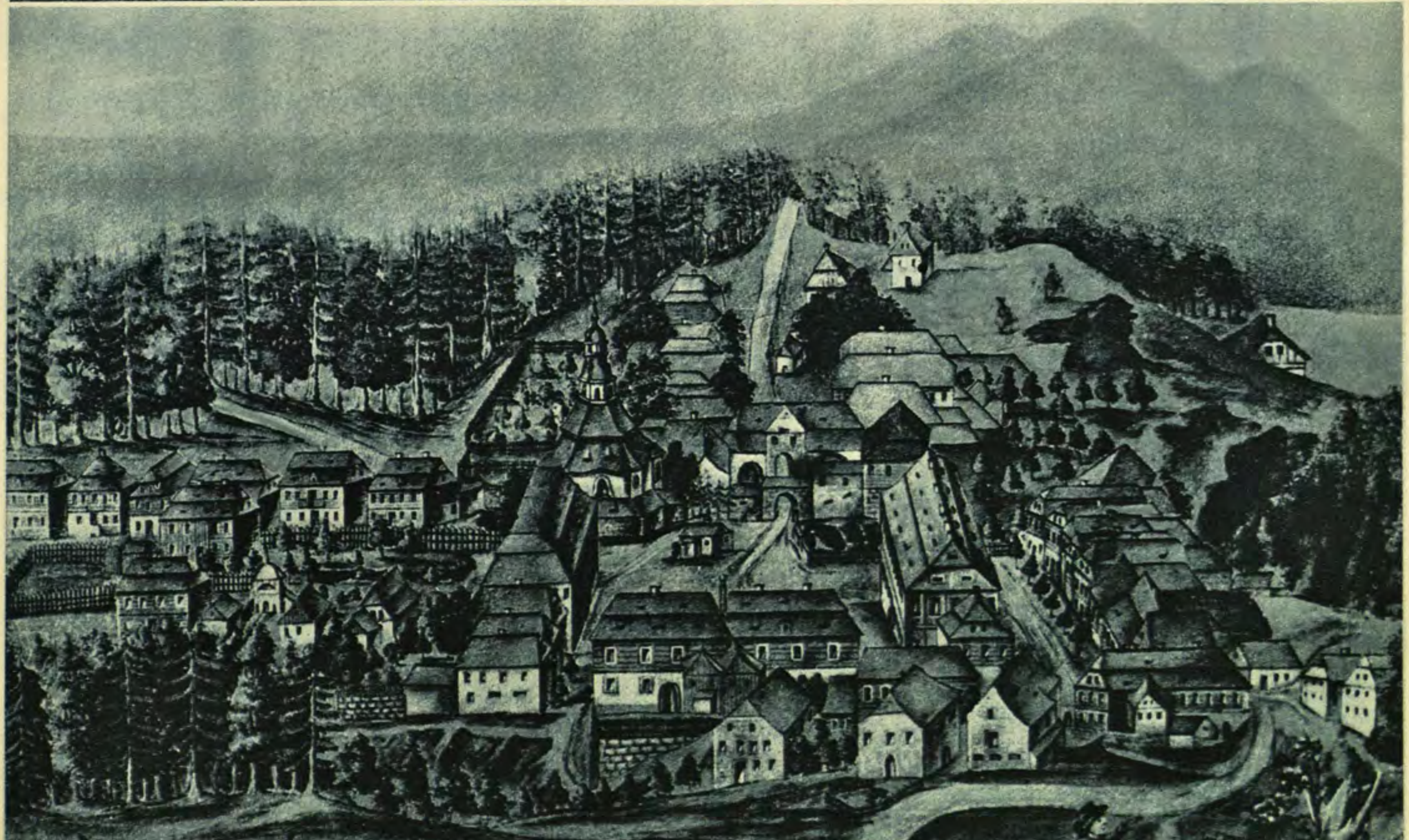


18. *Model of a Bohemian Glass Furnace, roughly from the year 1900. (Designed by Glass-House Master Franz Rückel.)*

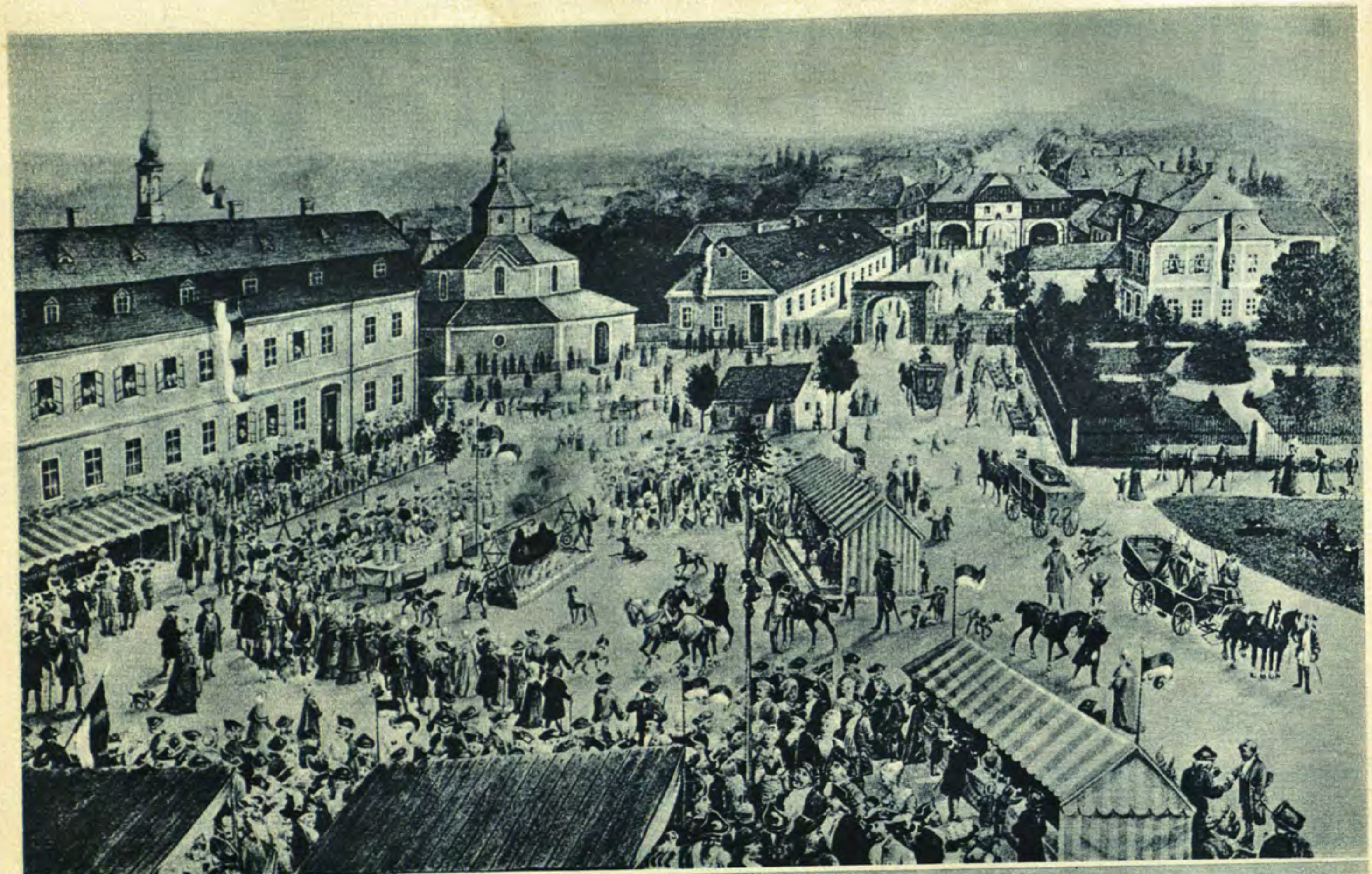


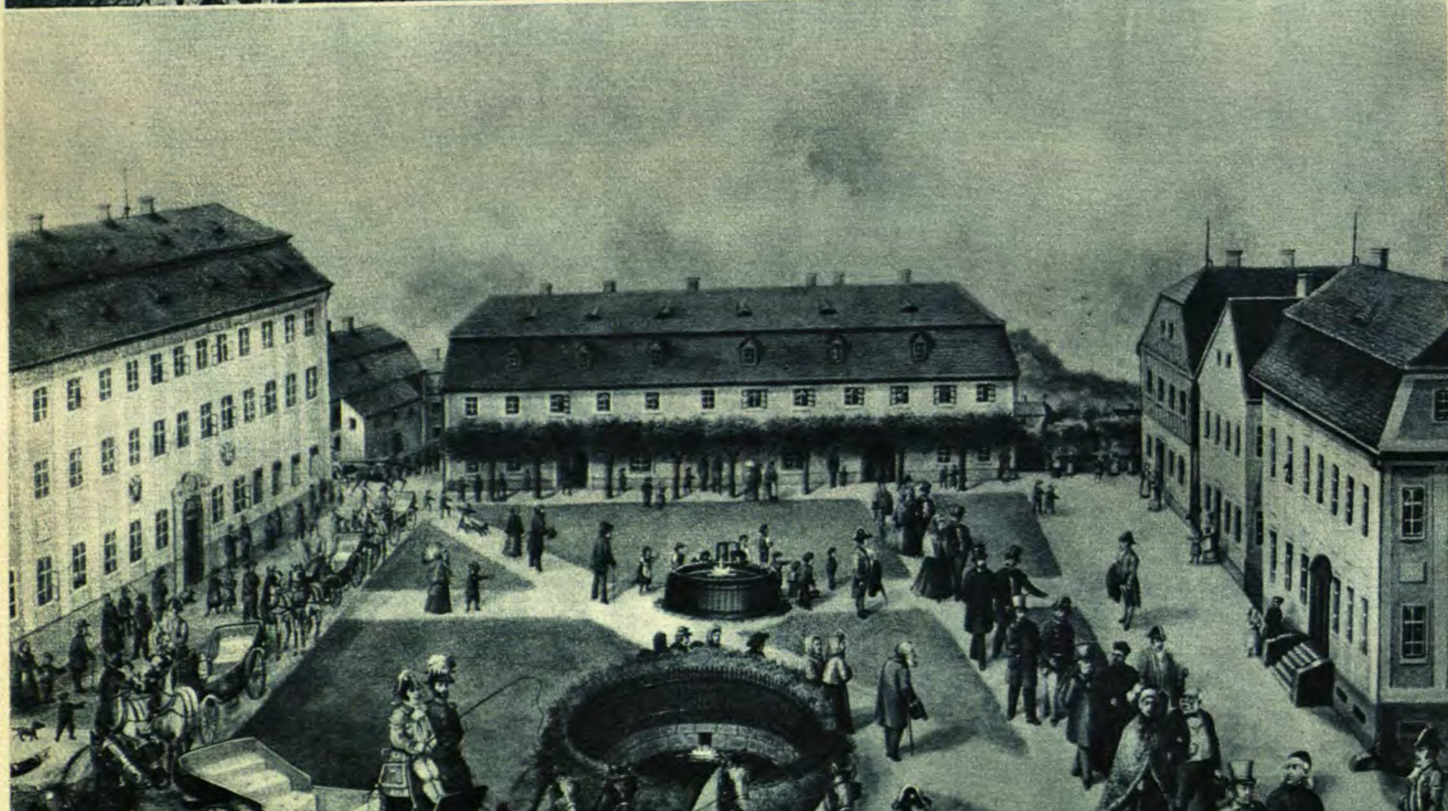
19. *The "Living Quarters" of the Collective of Glass-Makers at Breitenstein. End of the 19th Century.*



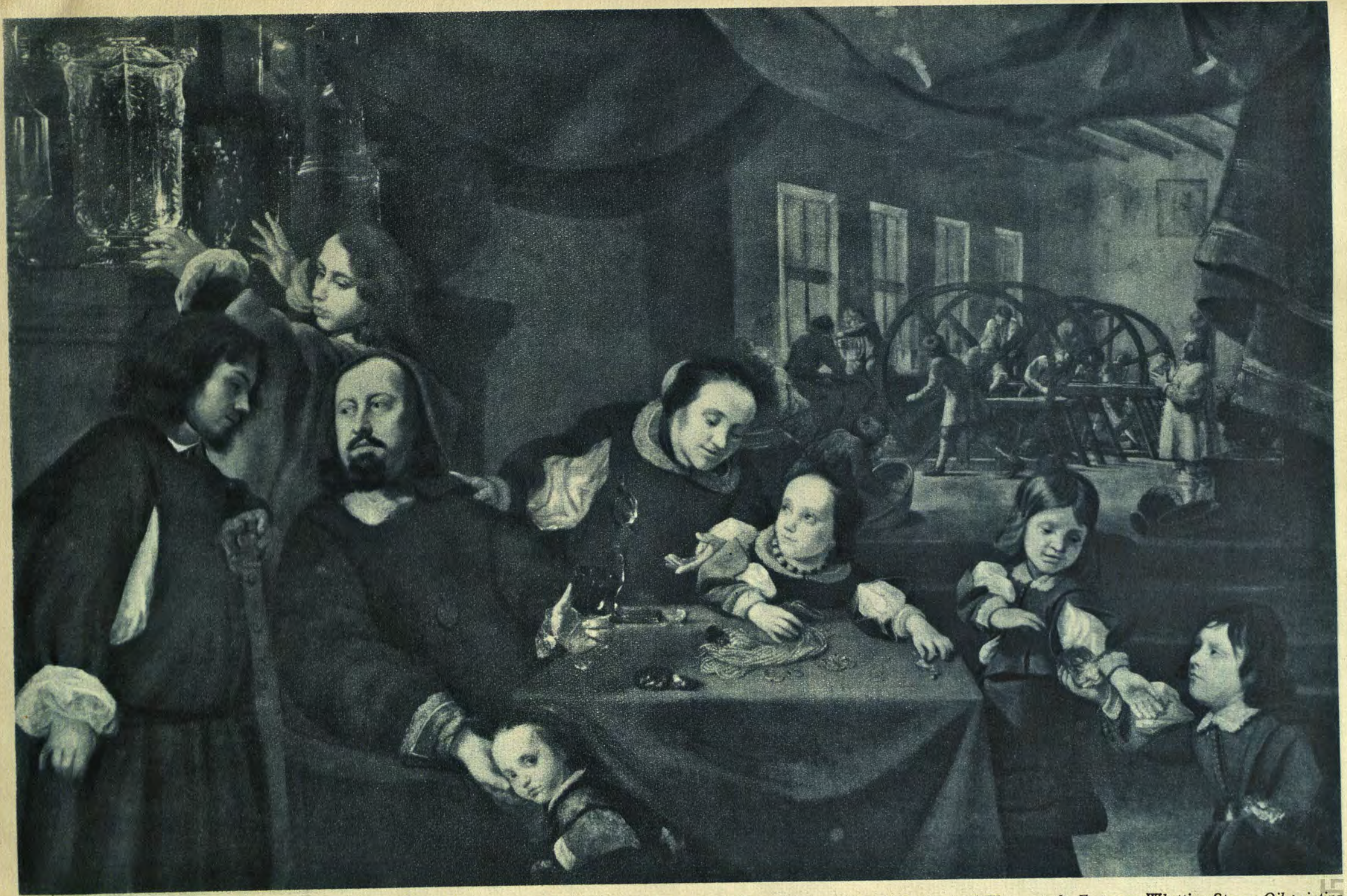


20. The "*Kittel Glass-House*" *at Chřibská According to a Contemporary Copper-Engraving from the End of the 18th Century. It is assumed that on this spot stood once the historic glass-house that functioned at the very beginning of Bohemian glass-making of which records have been preserved. Today the so-called* "*Training Glass-House*" *occupies this spot.* 21. *The North Bohemian Glass Metropolis Nový Bor in the Year 1784.*

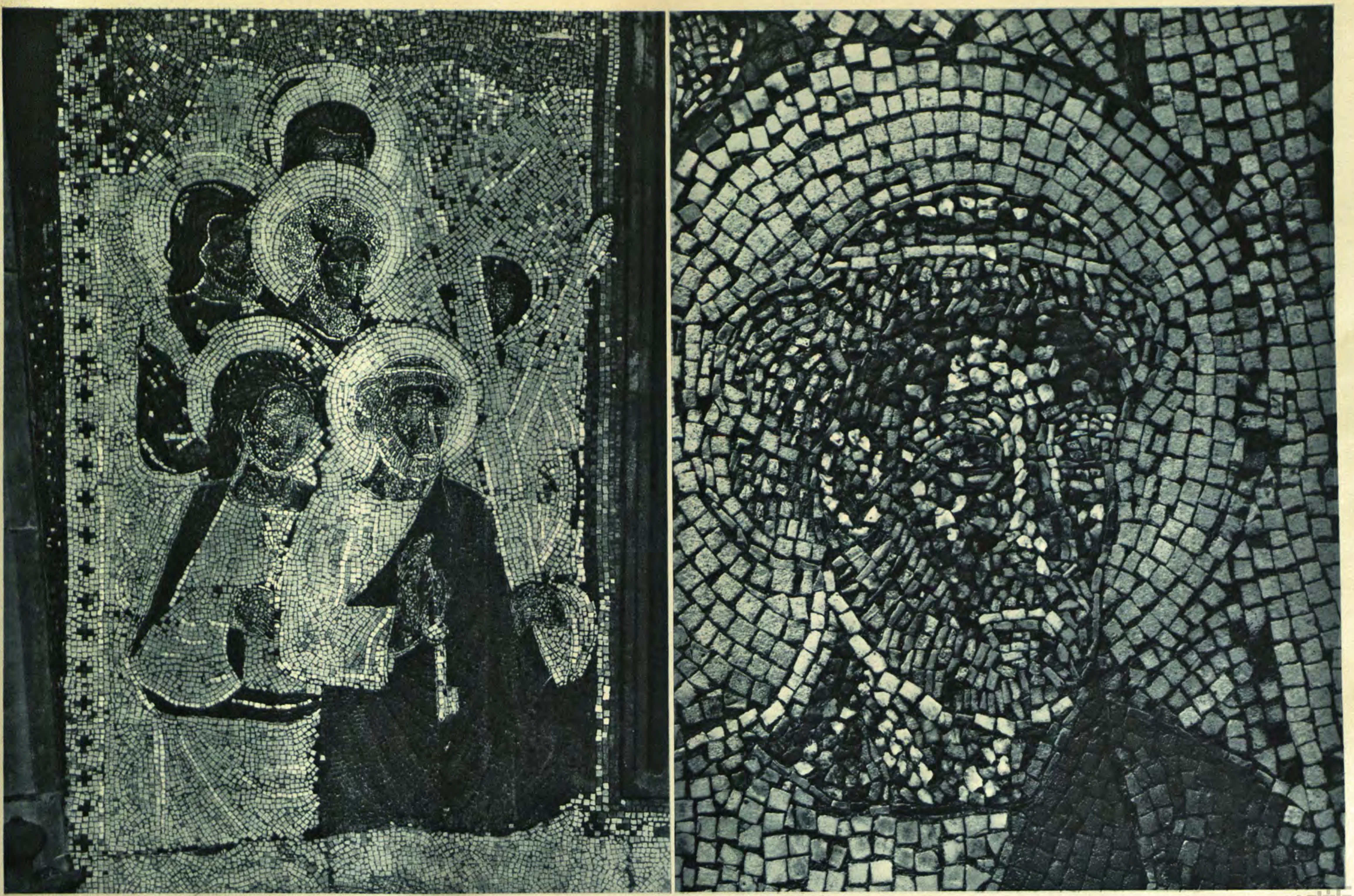




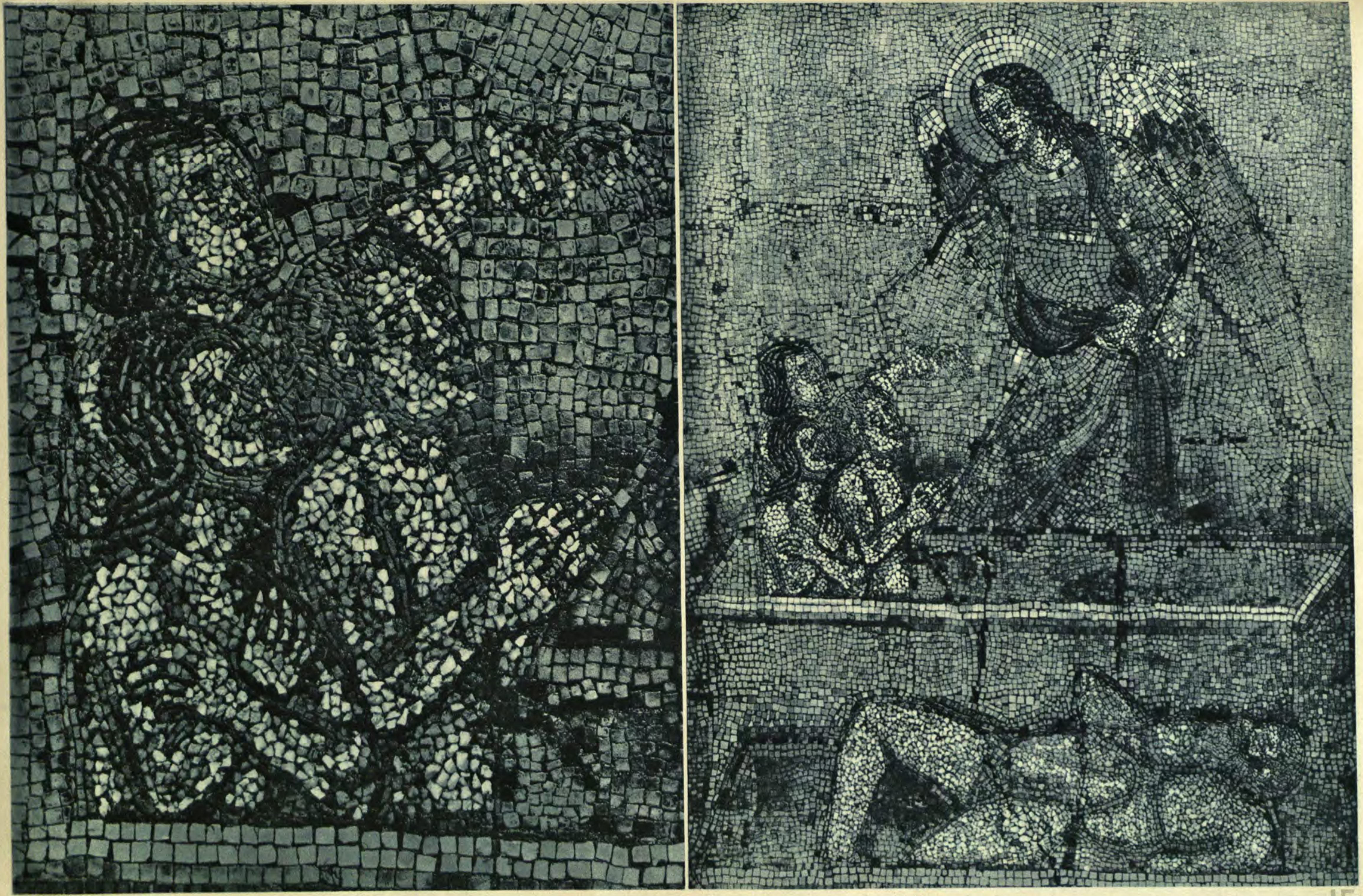
22. Merry-Making and a Roast on the Square in Nový Bor on February 20th, 1783.
23. F. Egermann Accompanies Emperor Ferdinand I (V) on the Square in Nový Bor in the Year 1855.



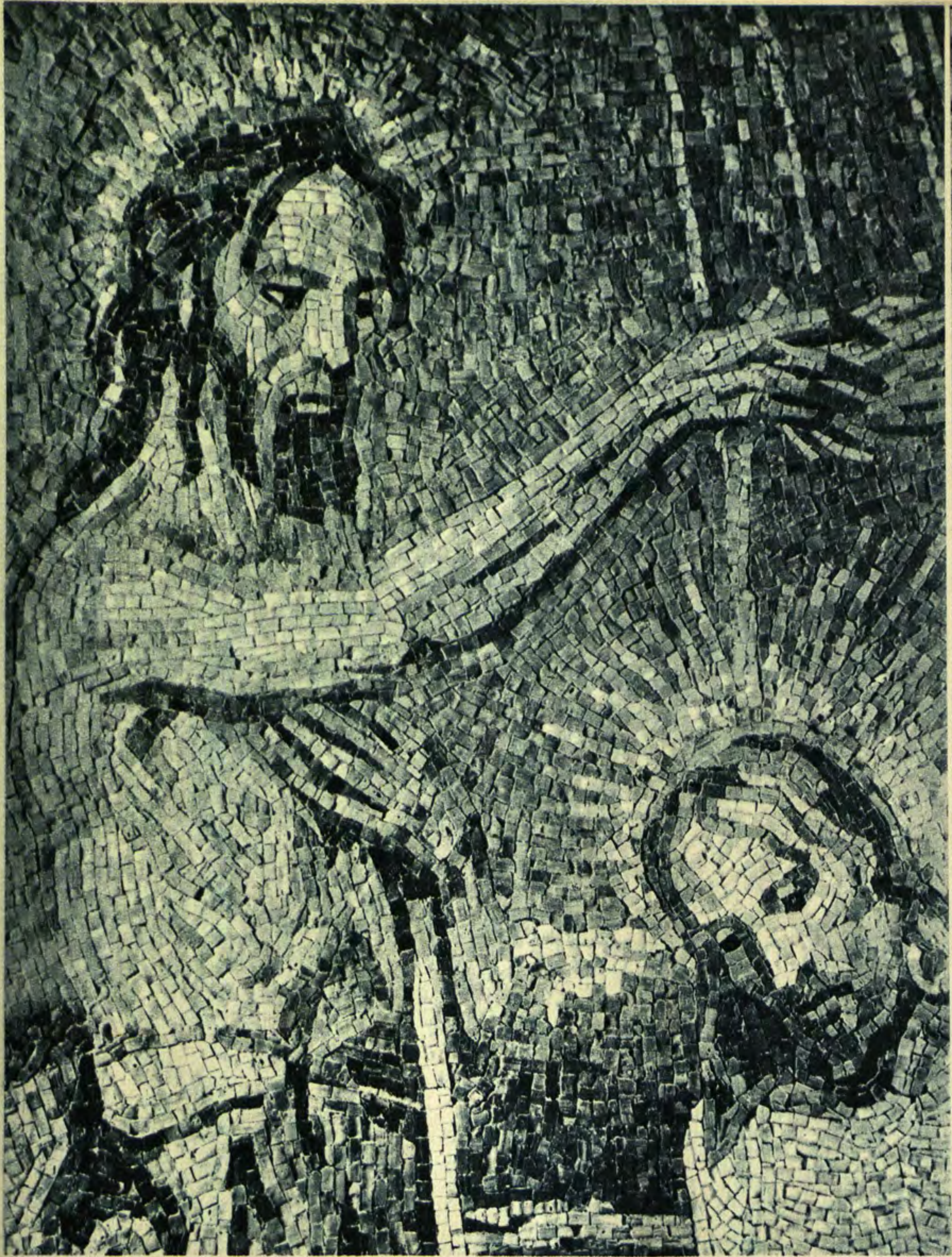
24. *Karel Škréta: The Family of the Prague Cutter of Precious Stones, the Keeper of the Royal Treasury Dionisio Miseroni. In the Background There are the Enormous Whetting Stones. Oil painting from the year 1653. (Prague National Gallery.)*



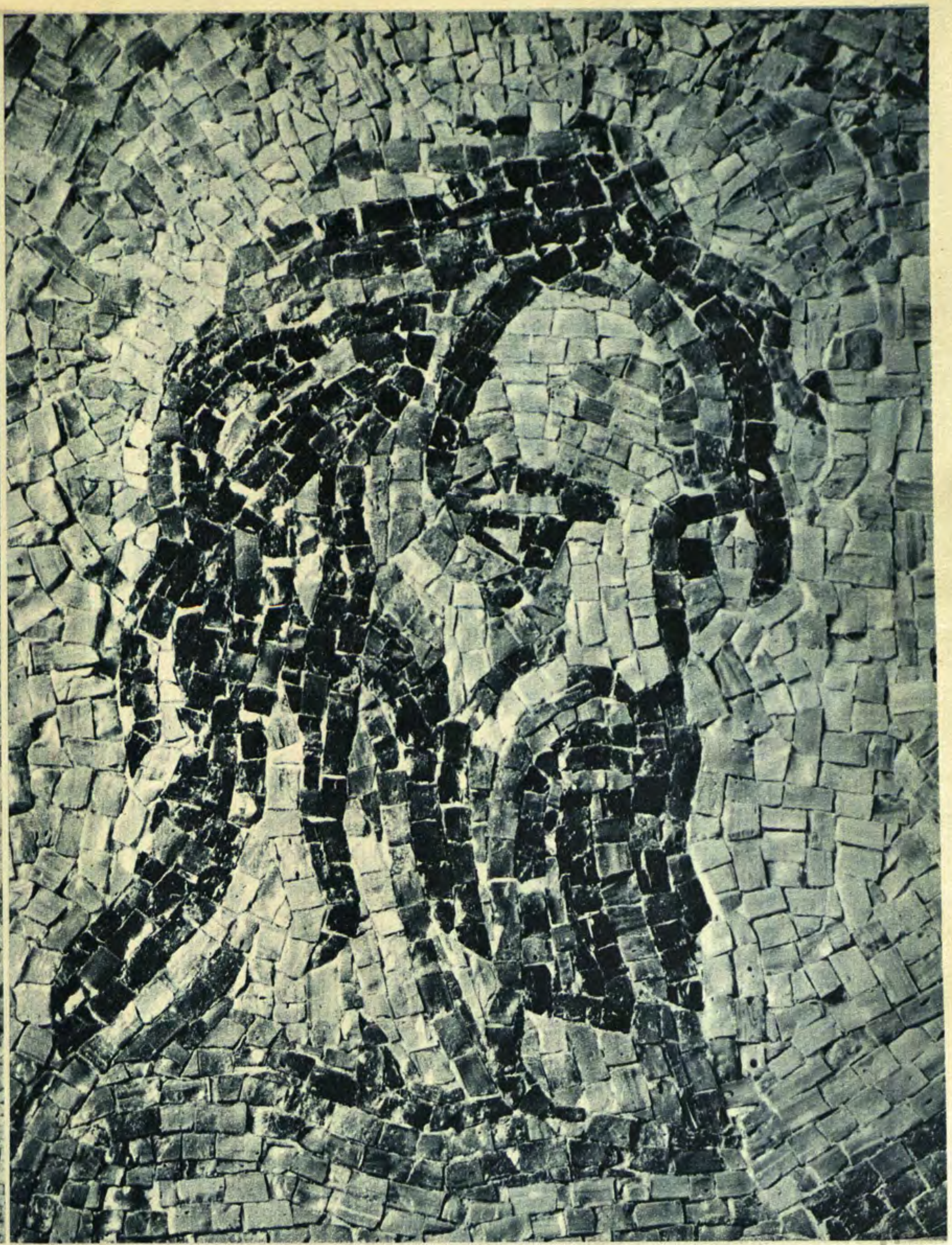
*25.—26. **Two** Sections of the Monumental Mosaic "The Last Judgement" over the South Portal of the St. Vitus' Cathedral in Prague. (Porta Aurea — Golden Portal) This Mosaic was Made on Order of Emperor Charles IV. Venetian Work. Photo: State Photometric Institute. Prague.*



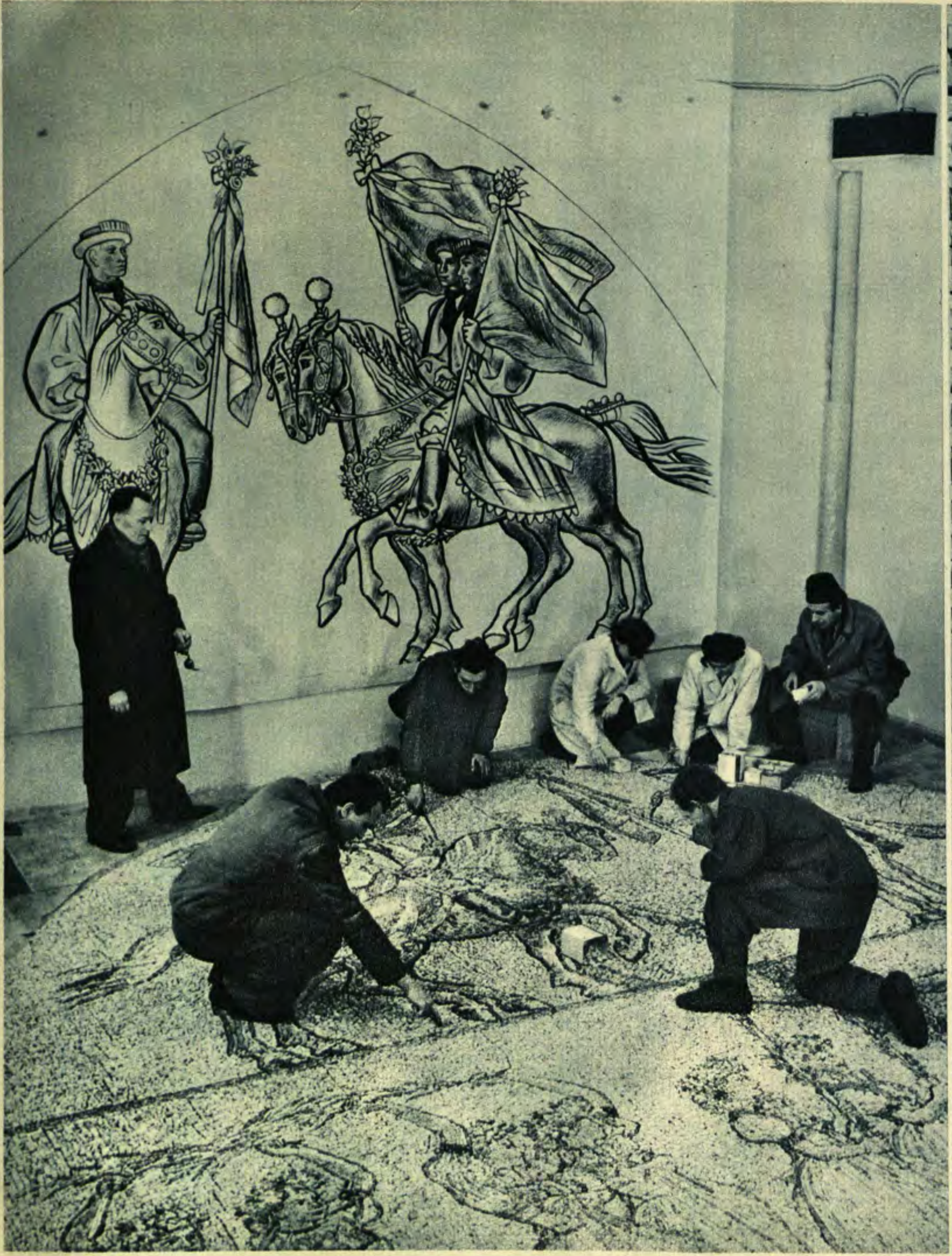
27.—28. Two Sections from the Mosaic: "The Last Judgement" over the South Portal of the St. Vitus' Cathedral in Prague. No similar work of the kind has been preserved in Bohemia.



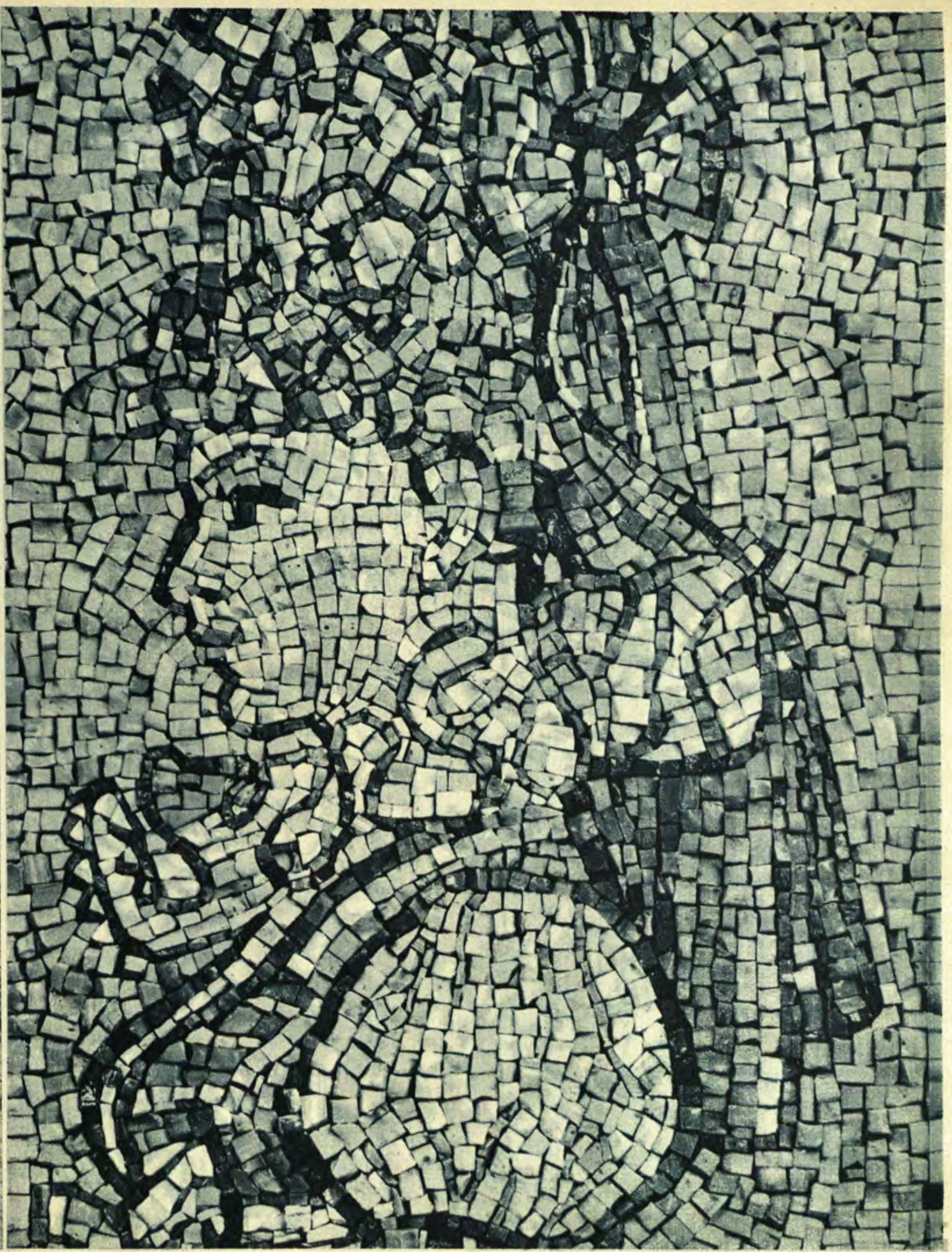
29. Prof. Max Švabinský: Detail from the Mosaic "The Baptism of Christ" in the St. Vitus' Cathedral in Prague. Executed by "Bohemian Mosaics", National Enterprise, in 1950. Photo: Glogar, Prague.



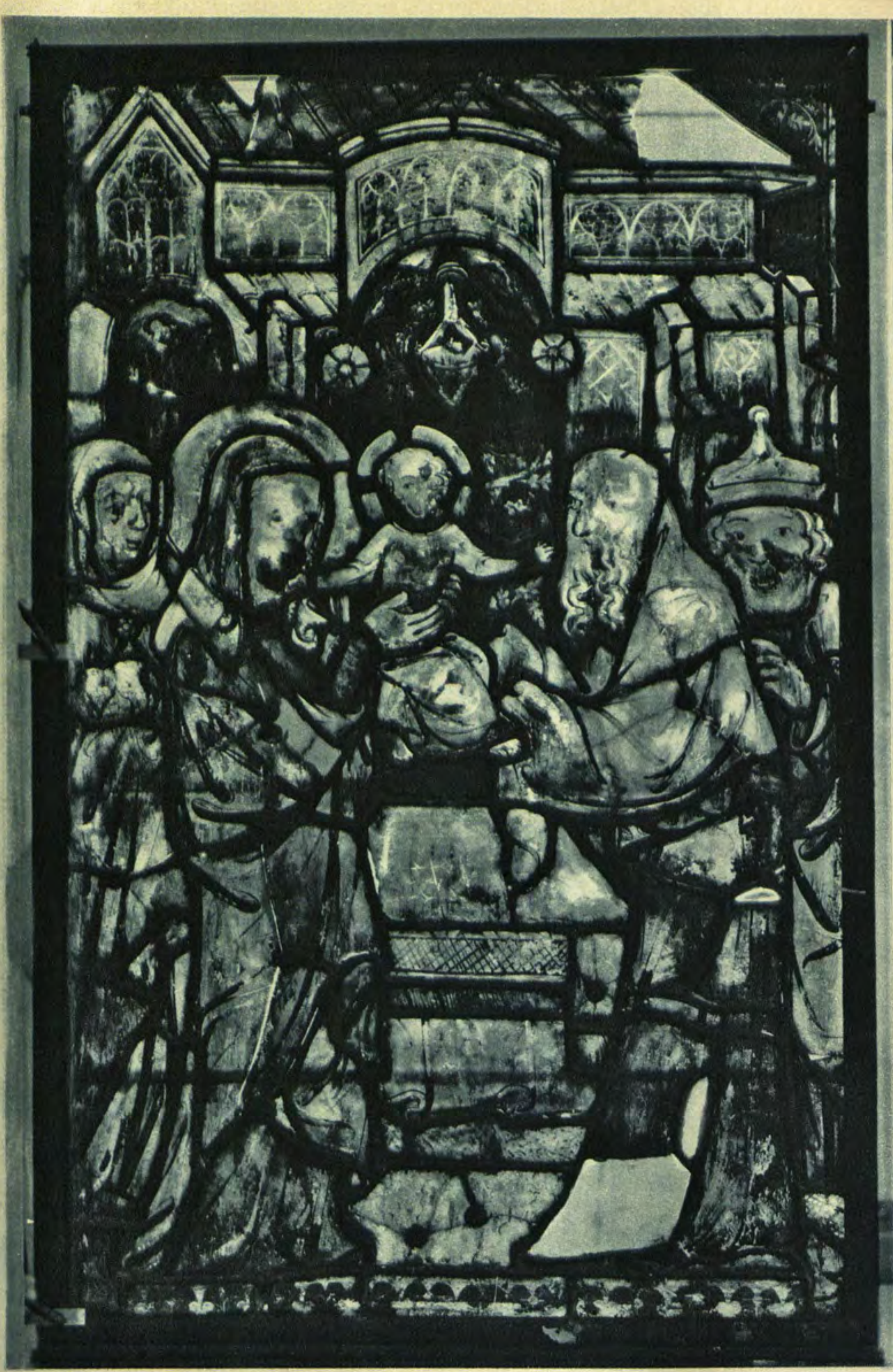
30. Prof. Max Švabinský: Head of John the Baptist. Detail from "The Baptism of Christ". Photo: Zdeno Feyfar, Prague.



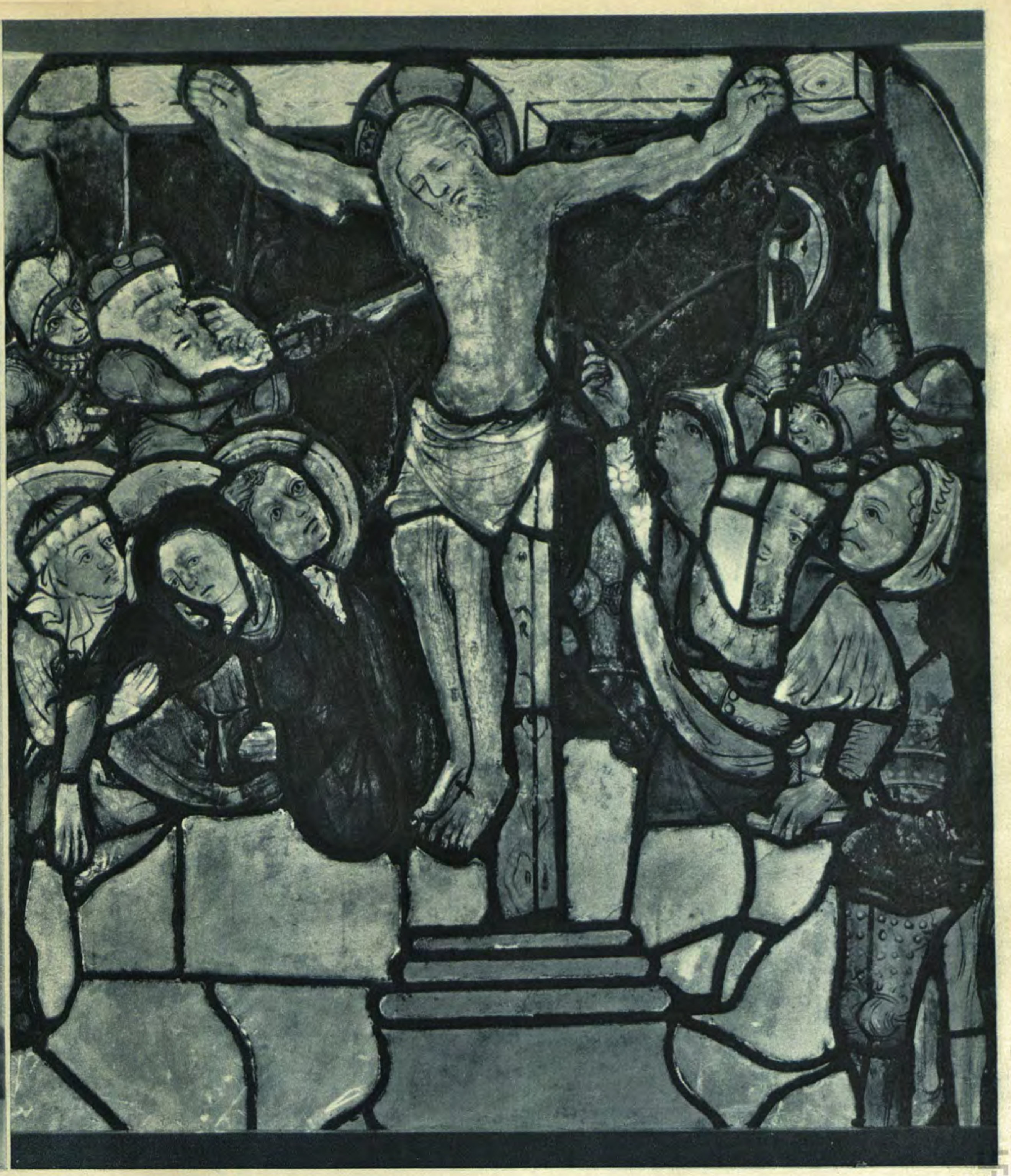
31. Prof. Karel Svolinský at Work at a Mosaic Picture for the Ancient Horologe in Olomouc. Executed by "Bohemian Mosaics", National Enterprise. Photo: F. Vopat, Prague.



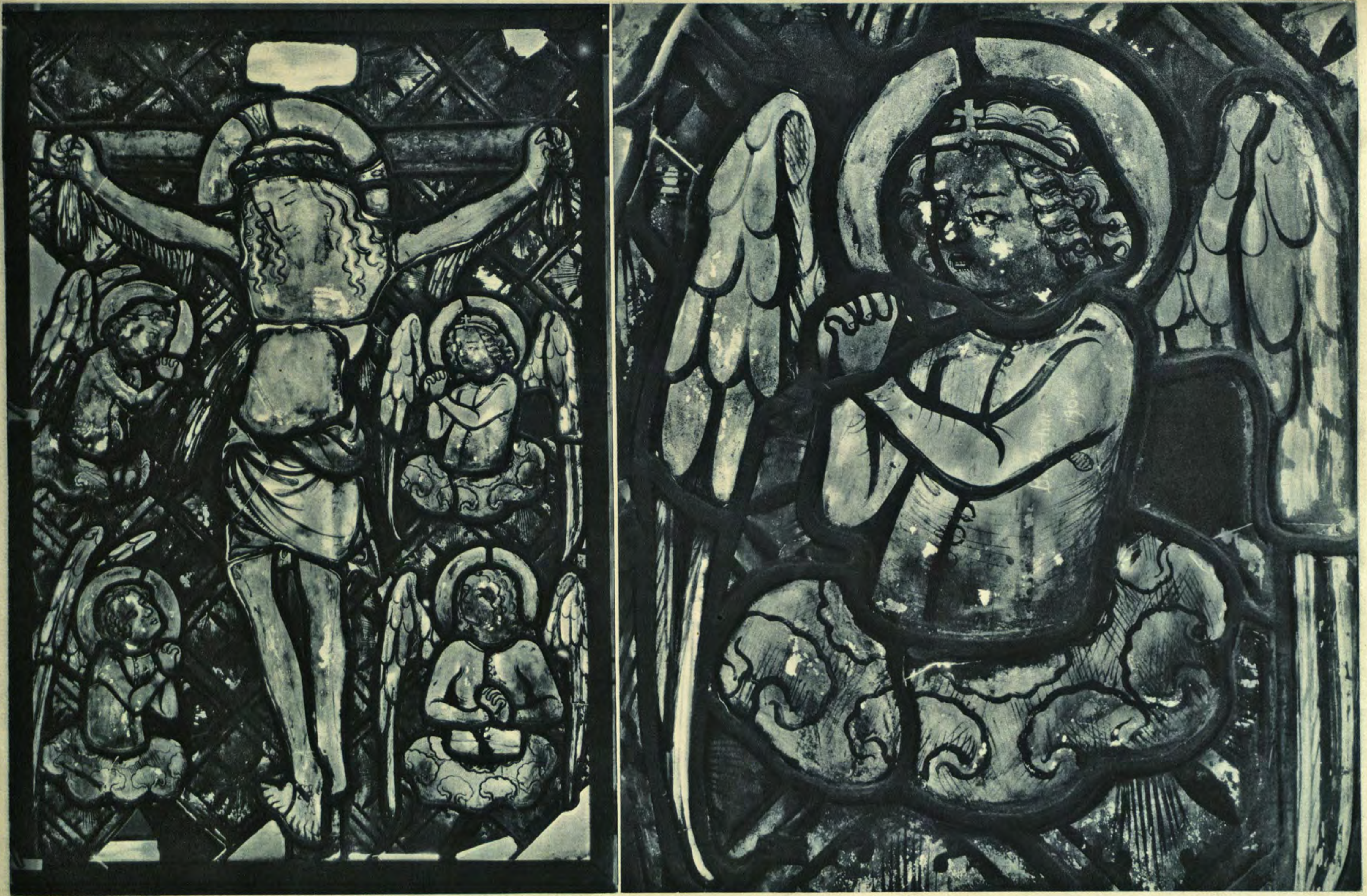
32. Prof. Karel Svolinský: Detail from the Mosaic for the Horologe in Olomouc.



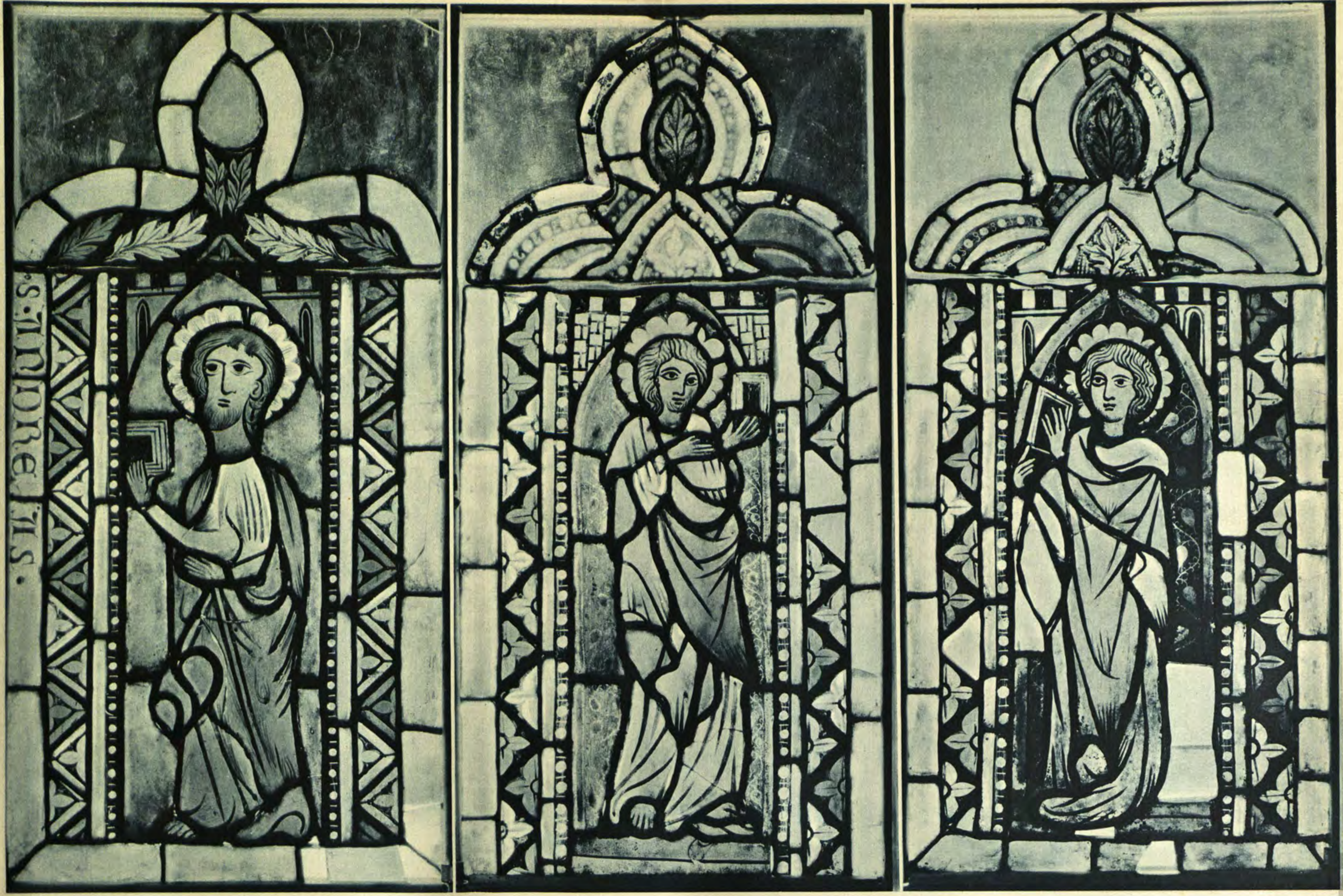
33. Detail of a Painted Gothic Window in the St. Bartholomew Cathedral in Kolín on the Elbe, Bohemia, End of 14th Century. Photo: State Photometric Institute, Prague.



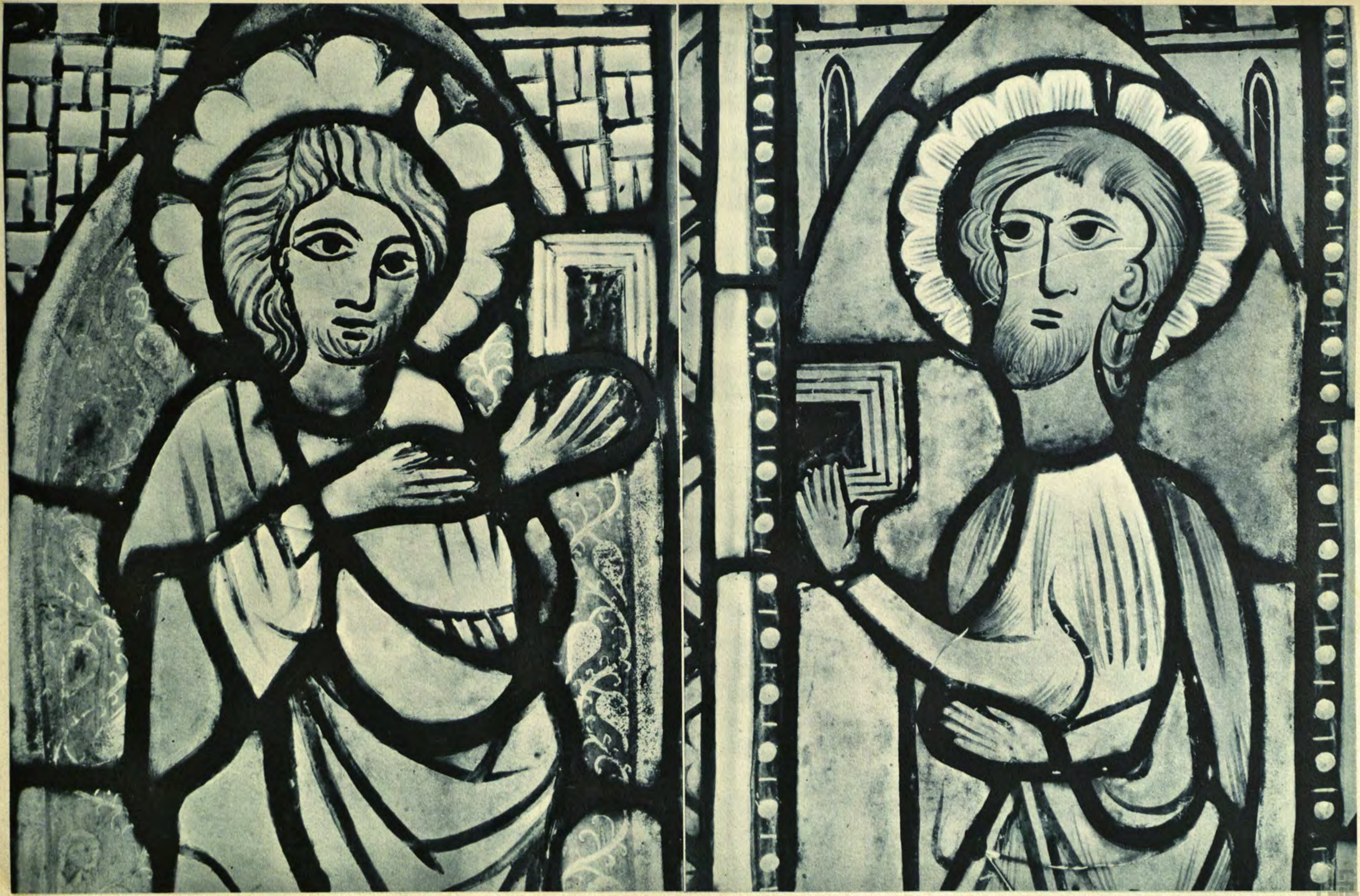
34. "The Crucifixion of Christ", a Gothic Window Made of Stained and Painted Glass in the Catherine Chapel at Castle Karlstejn in Bohemia. Originated in the Eighties of the 14th Century. Photo: State Photometric Institute, Prague.



35.—36. *Details of a Painted, Gothic Window in the St. Bartholomew Church in Kolín, 1380. Photo: State Photometric Institute, Prague.*



37.—38.—39. Three Gothic Windows, Made of Stained and Painted Glass, in the Parish Church at Žebnice. Originated in the First Half of the 14th Century. The Reproductions belong to the Archives of the State Photometric Institute in Prague. The Windows are now in the National Museum in Prague.

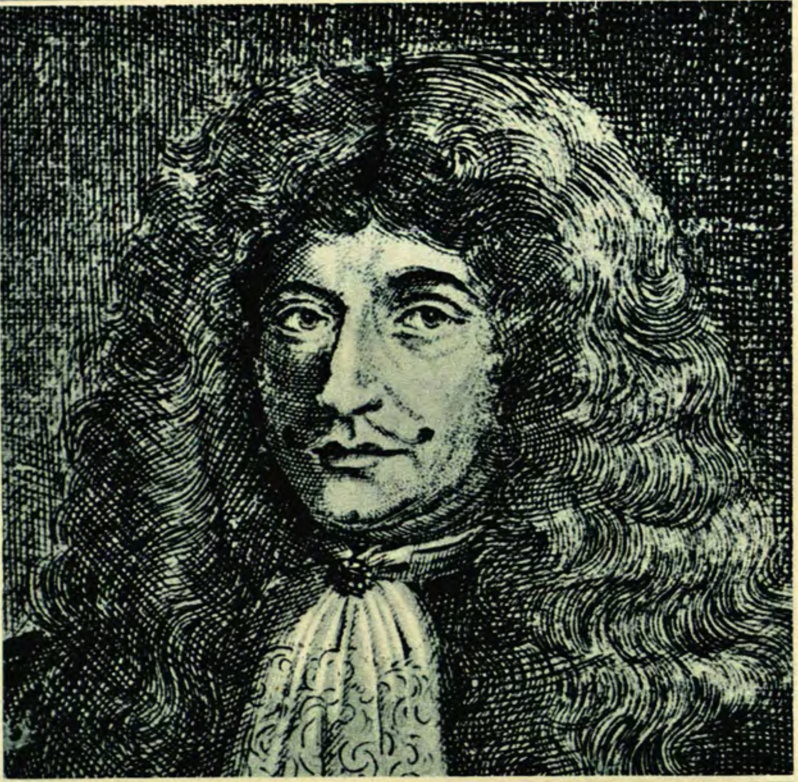


40.—41. *Two Sections of the Window in the Parish Church at Žebnice.*

42

43

44



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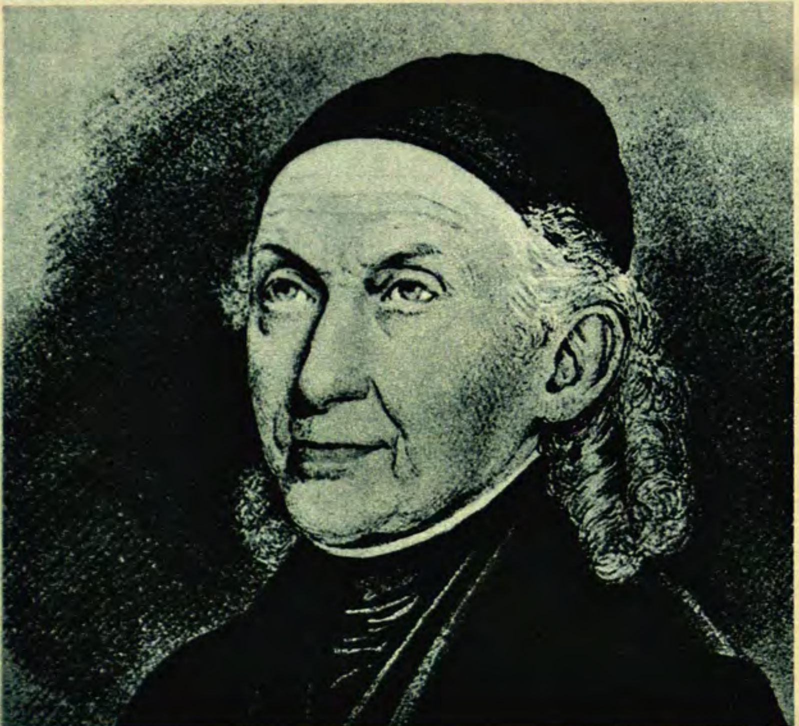
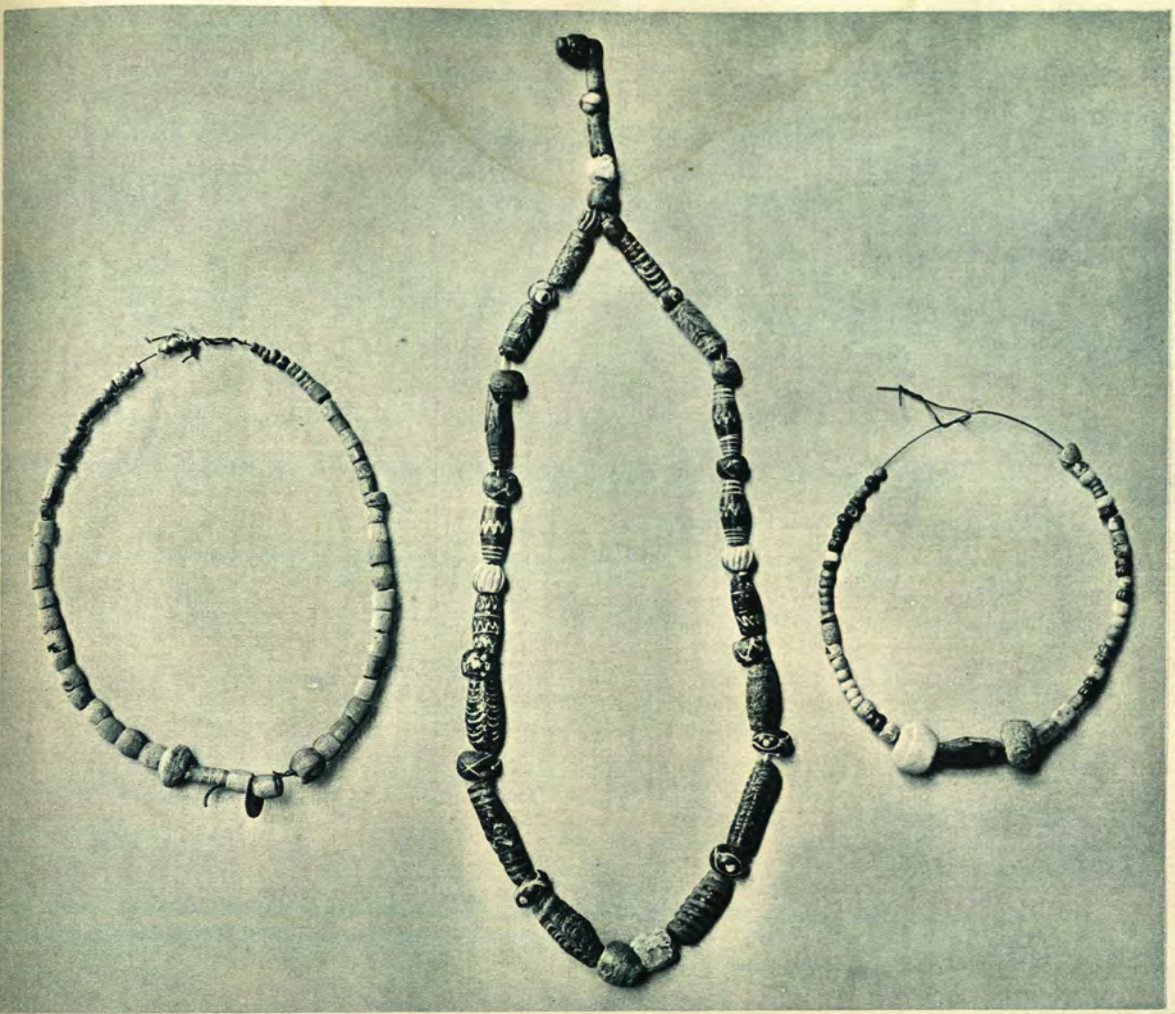
46a



46b

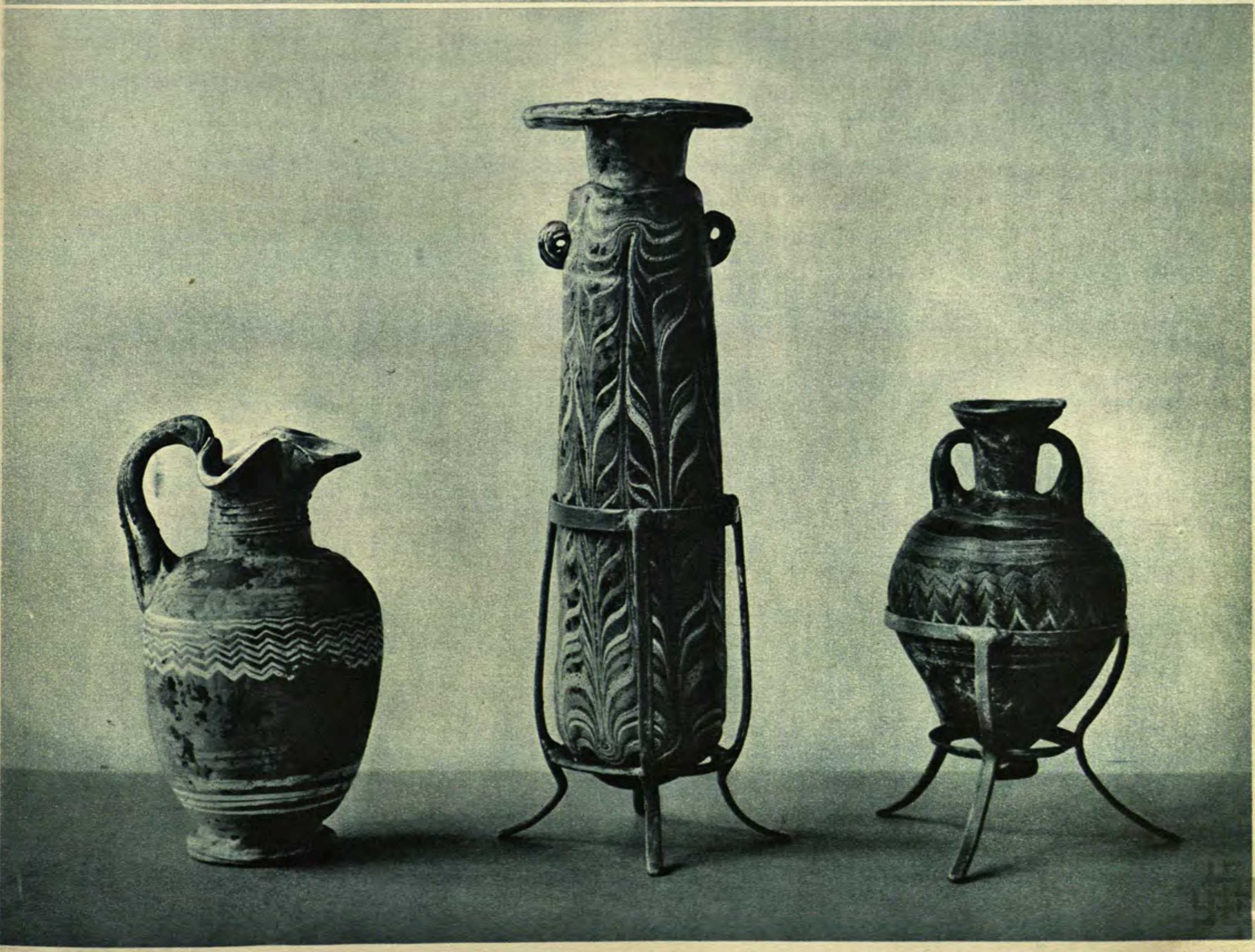
Six Famous Figures in the History of Glass.

42. Georg Agricola (Contemporary Copper-Engraving). 43. Jacopo Versalini. 44. Glass-House Master Elias Wander, According to an Oil Painting from the Year 1600. In the Glass Museum in Jablonec. 45. Johann Kunckel (Contemporary Copper-Engraving). 46. Dominicus Biman, According to a Hodenius Drawing from the Year 1833 and Friedrich Egermann, According to a Lost Oil Painting.

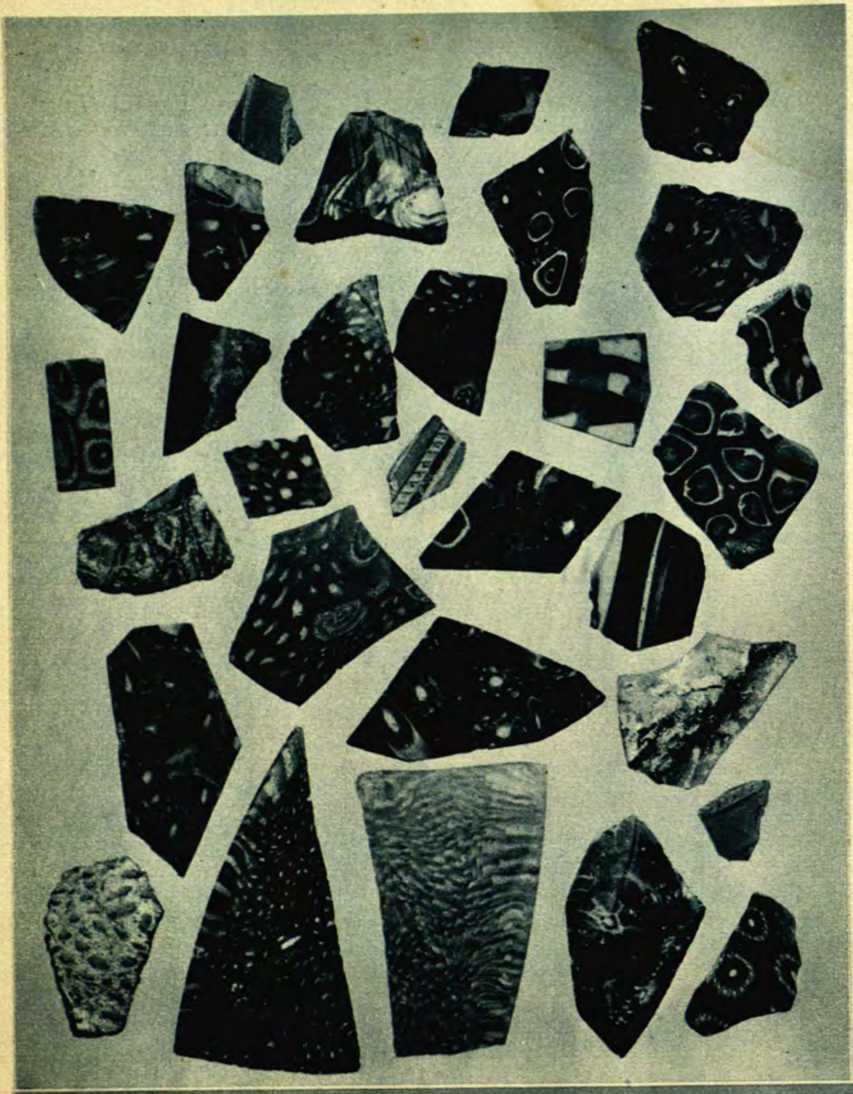


47. *Decorative Beads, an old Egyptian Product from the pre-Roman Epoch. (Prague Arts and Crafts Museum hereafter shortened to PACM.)*

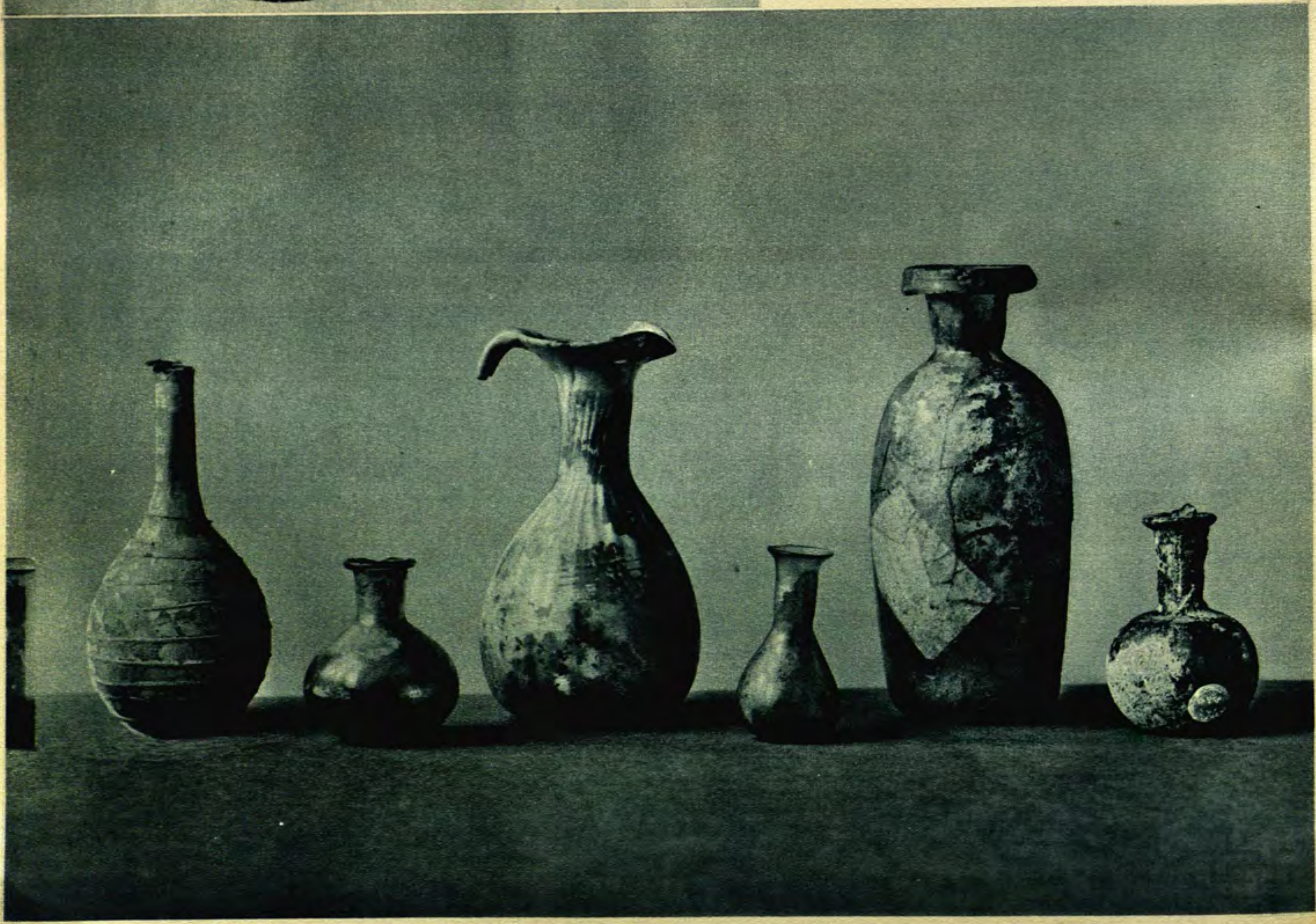
48. *Old Egyptian Balsam Containers with Combed Threads of Opaque, Coloured Glass (PACM).*



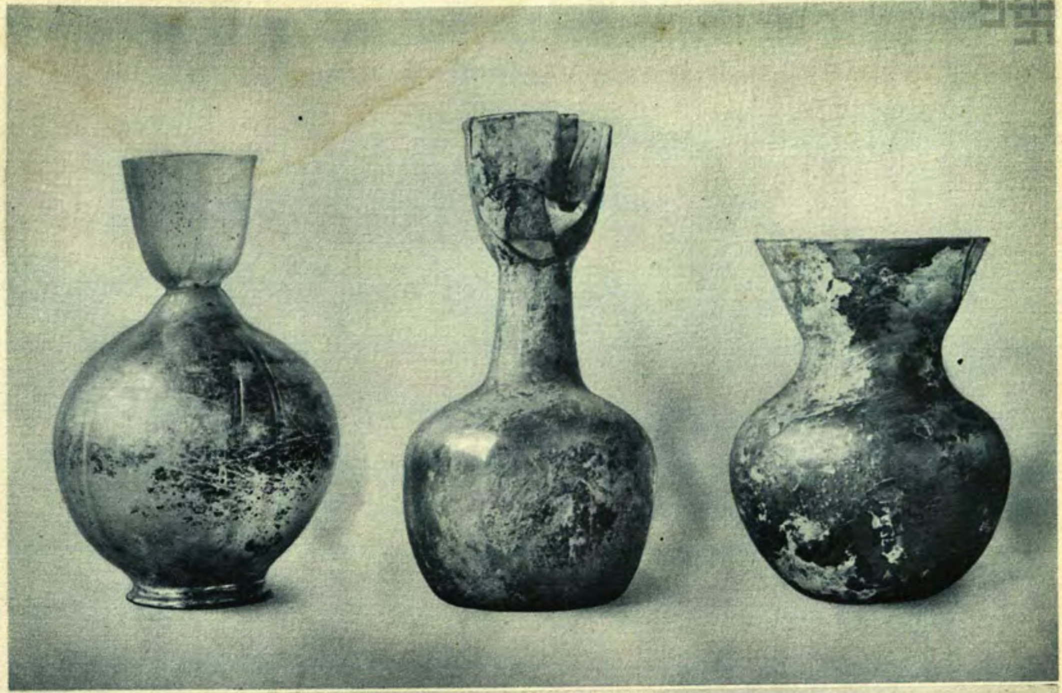
49. *Fragments of the Ancient, Multi-Coloured Opaque Glass "Murrina". (PACM)*



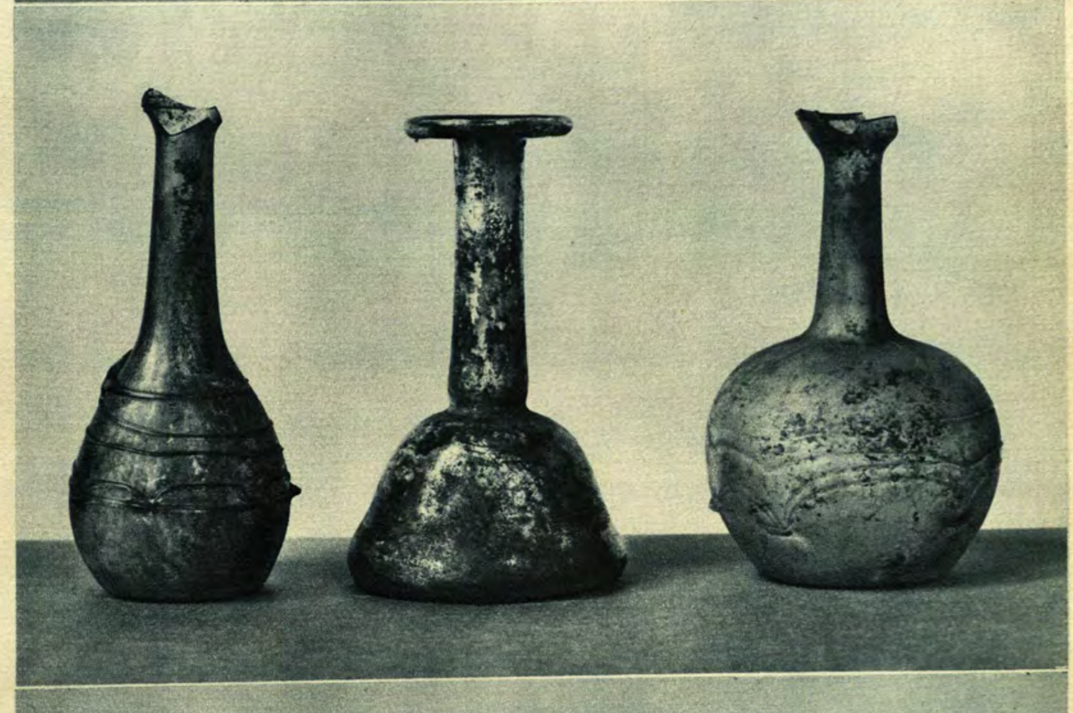
50. *Ancient Glass Vessels of Roman Provenance.*



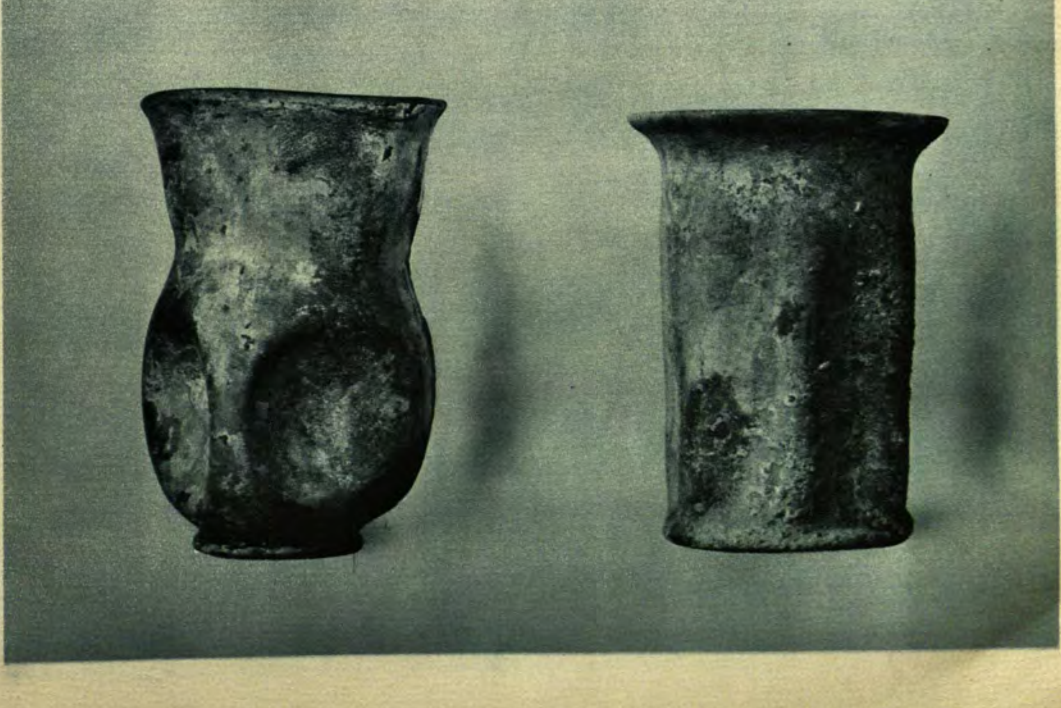
51. *Ancient Glass Vessels of Roman Provenance.*

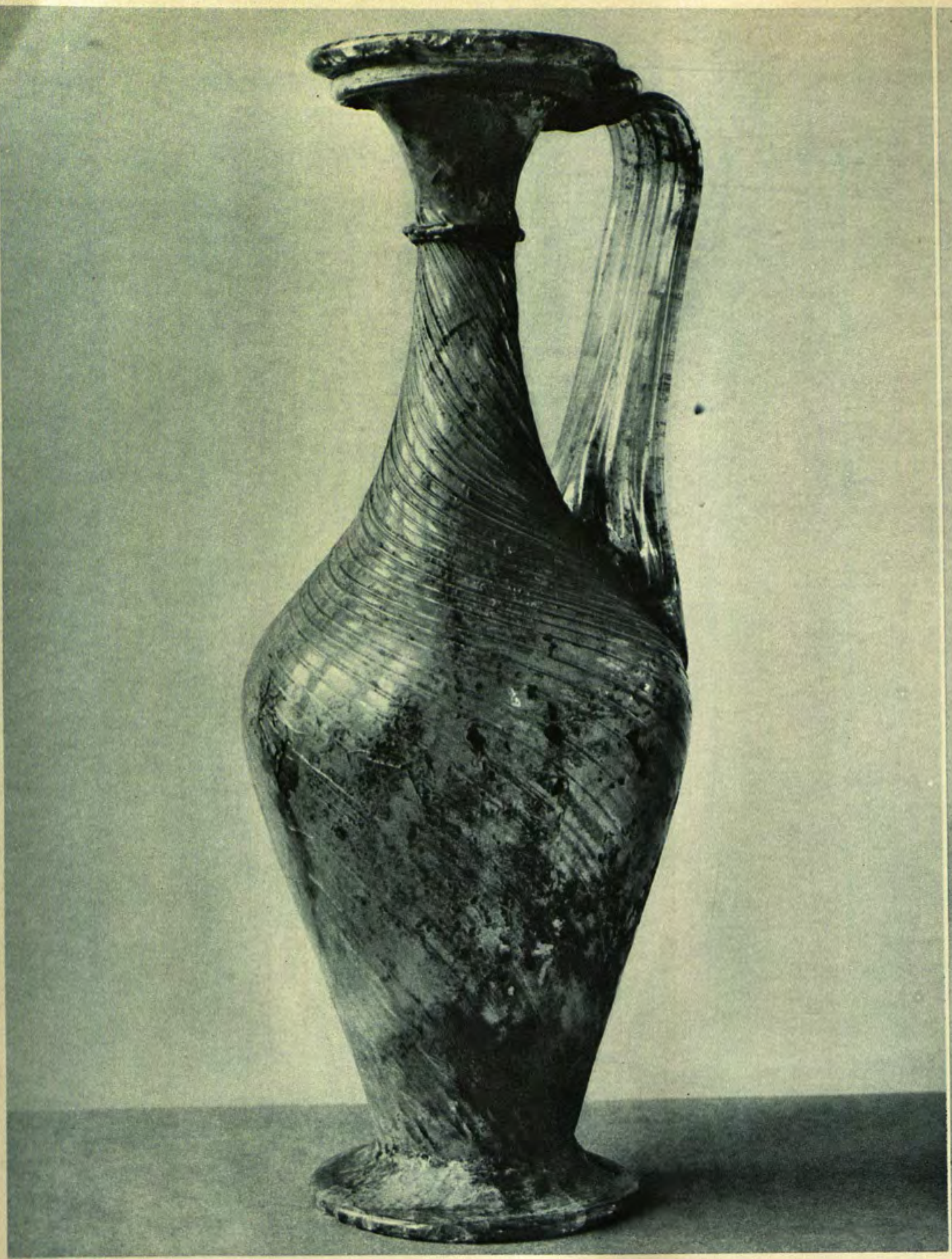


52. *Ancient Glass Vessels of Roman Provenance.*

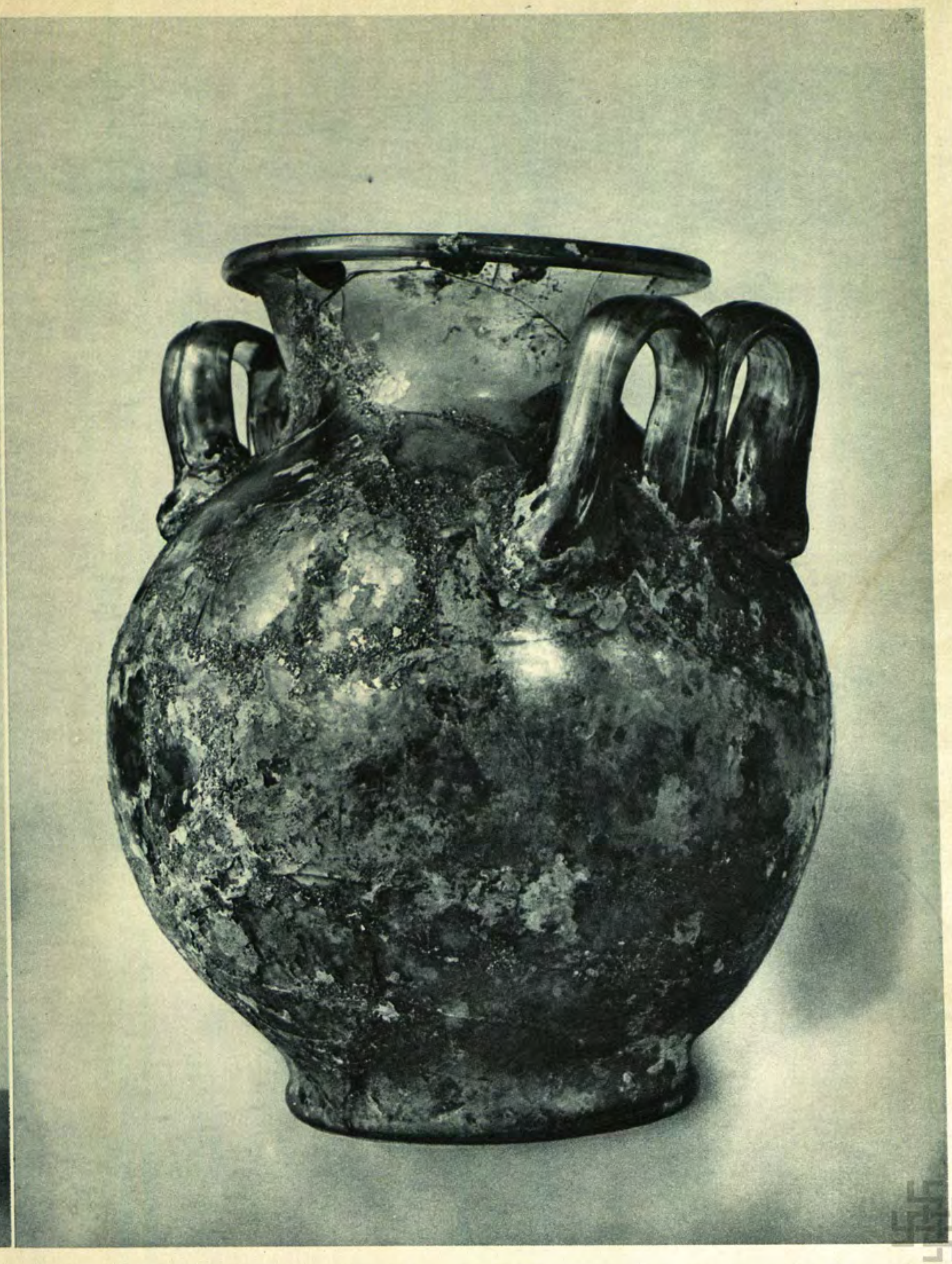


53. *Old Roman Glass of the Later Period. 4th Cent. A. D. The Goblet on the Left was Found in France.*
(PACM)

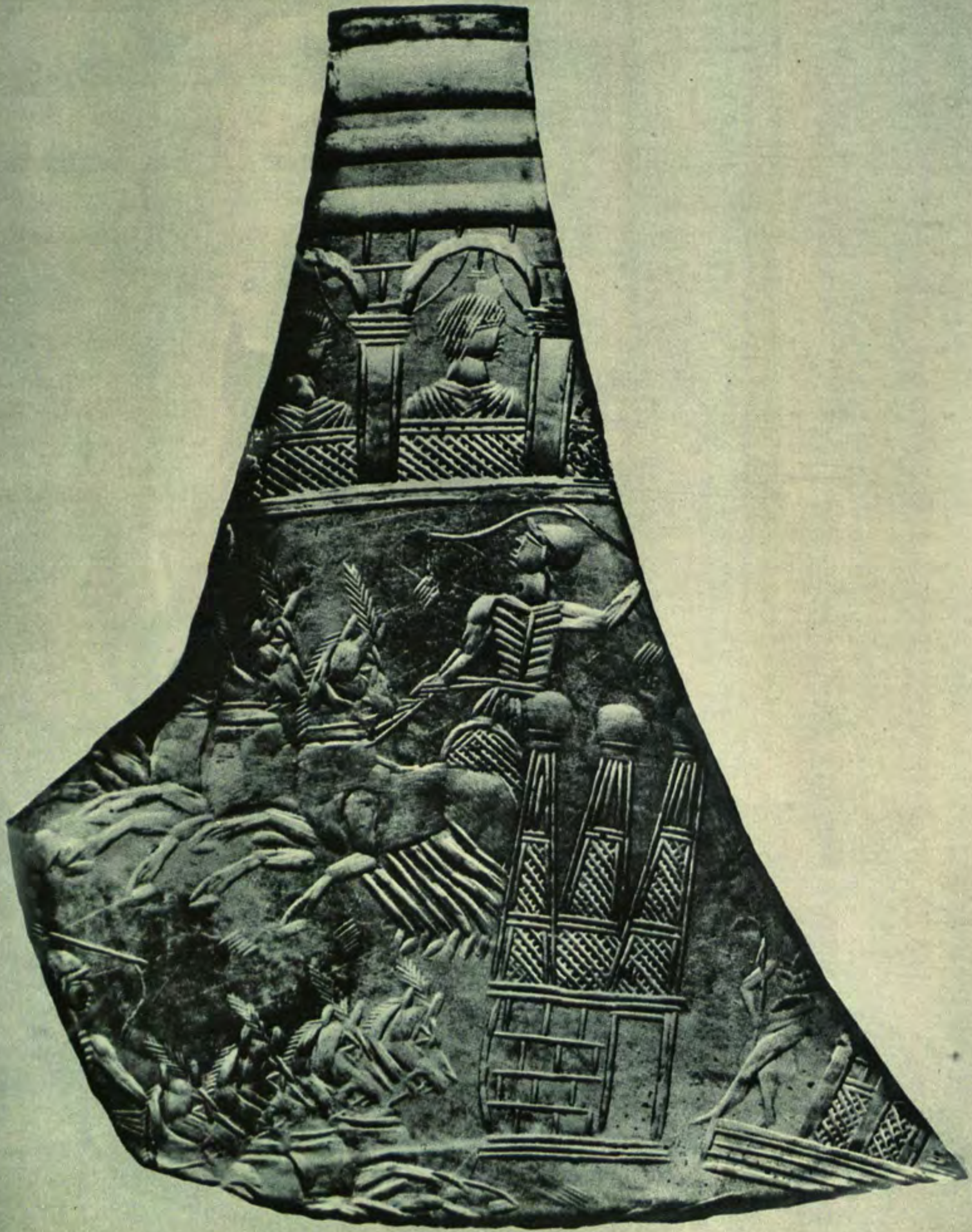




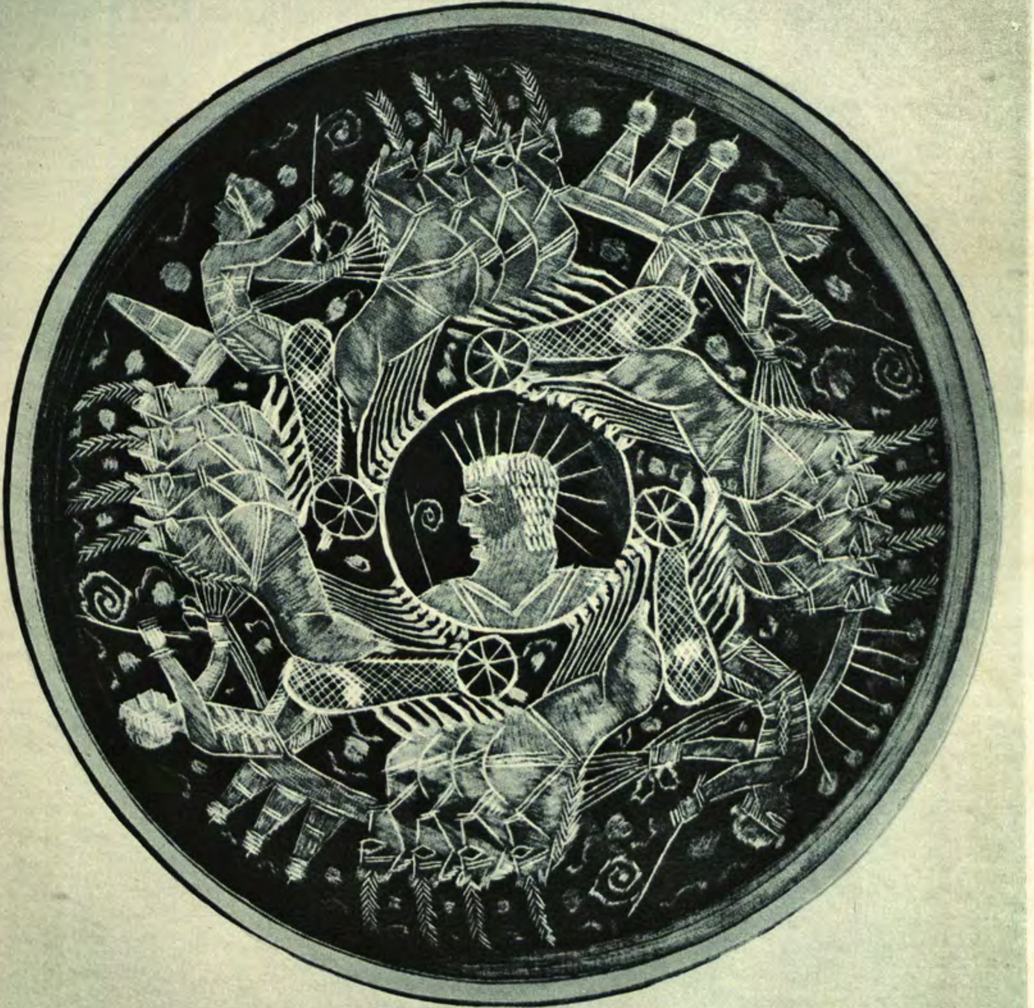
54. *Ancient Glass Flask with a Handle. (PACM)*



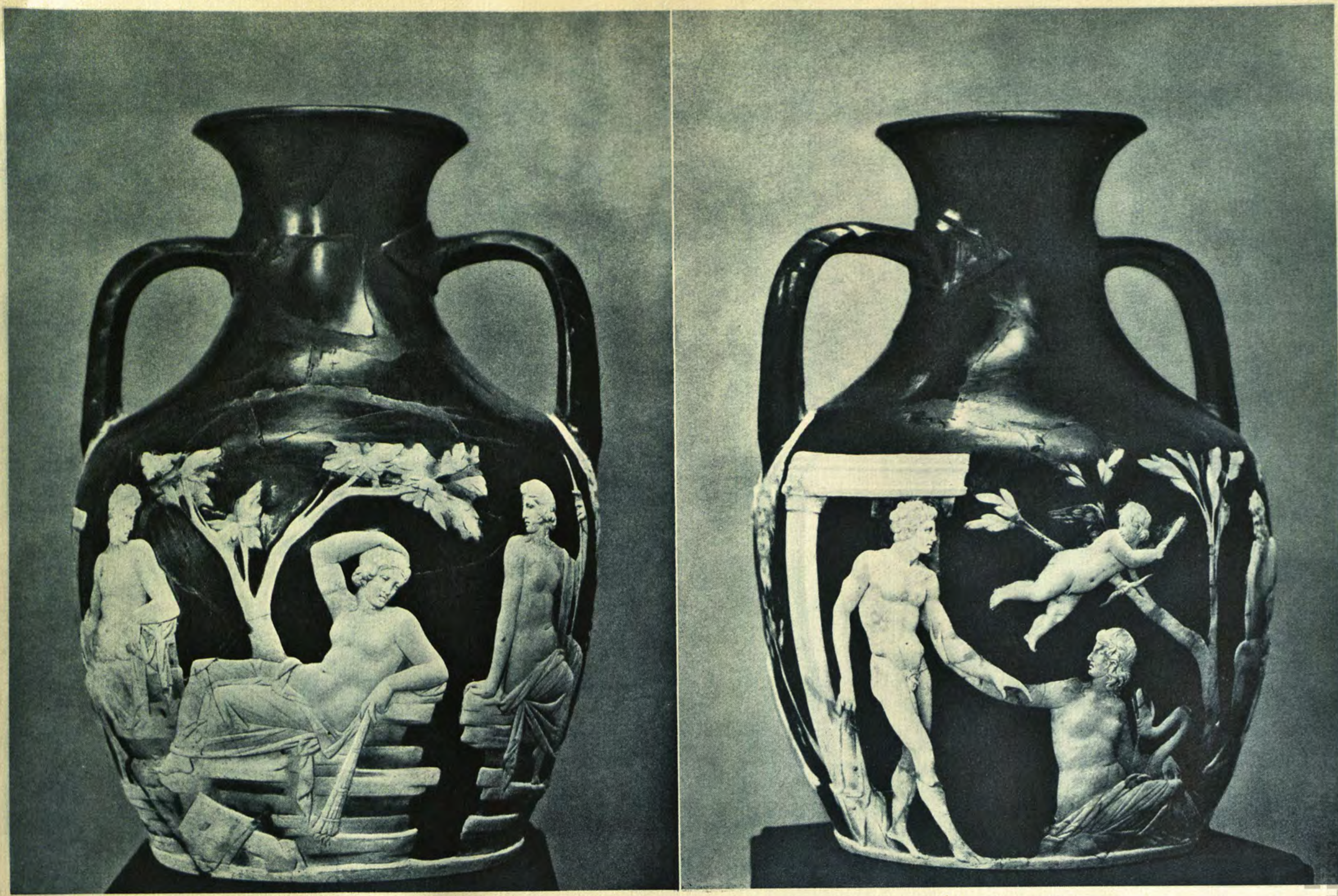
55. *Old Roman Glass Urn with Two Handles, Container Missing. (PACM)*



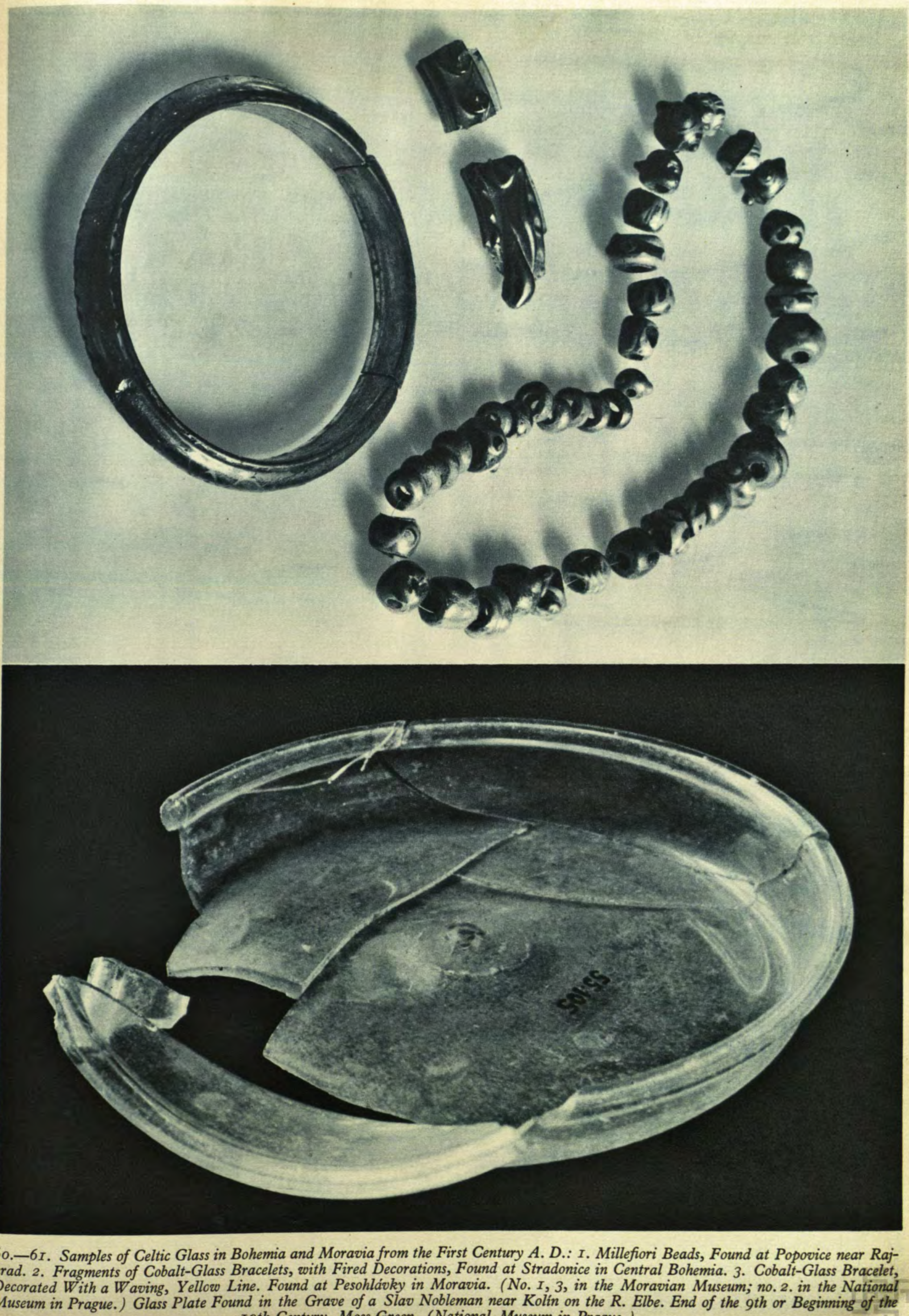
56. *Gladiator in the Circus. Fragment of a Glass Engraving Found in the Rhineland.*



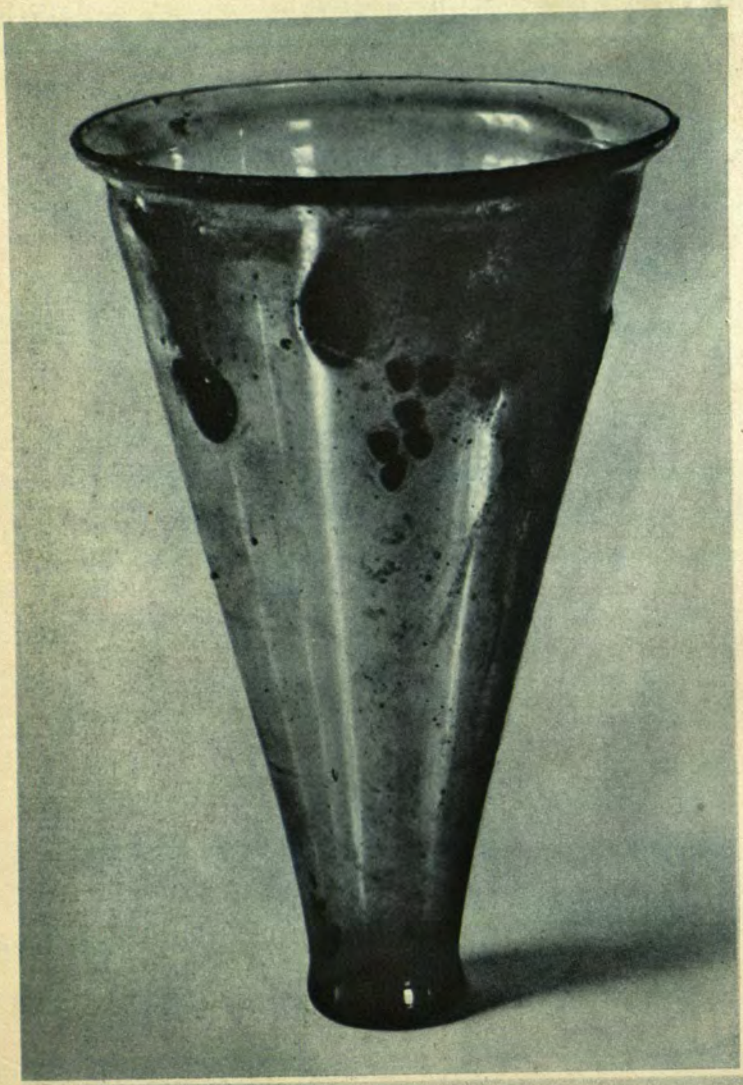
57. *Gladiator in the Circus. Engraved Glass Cup found at Cologne.*



58.—59. *The Portland Vase. Cobalt Glass "Overlaid" with White Glass.*

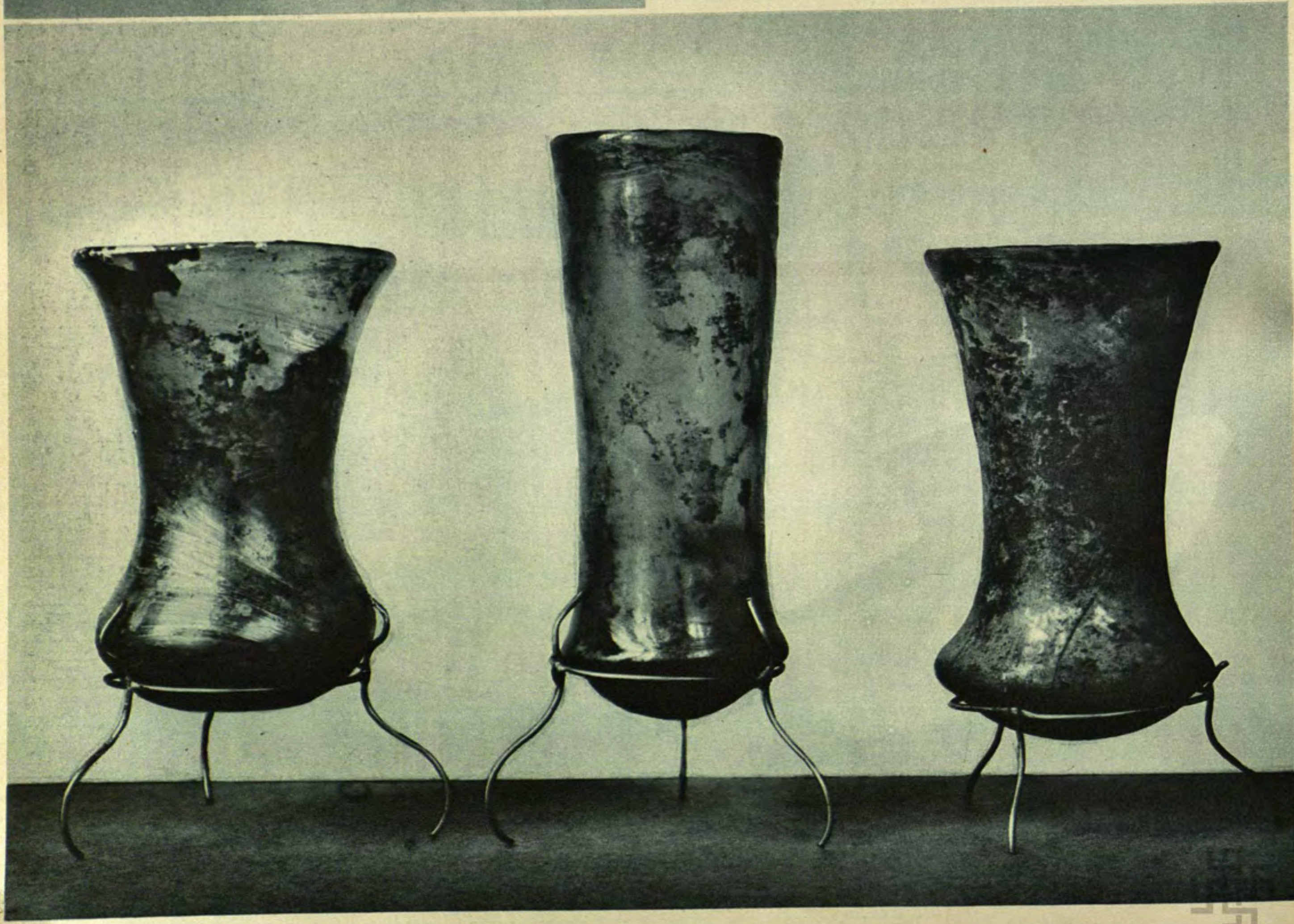


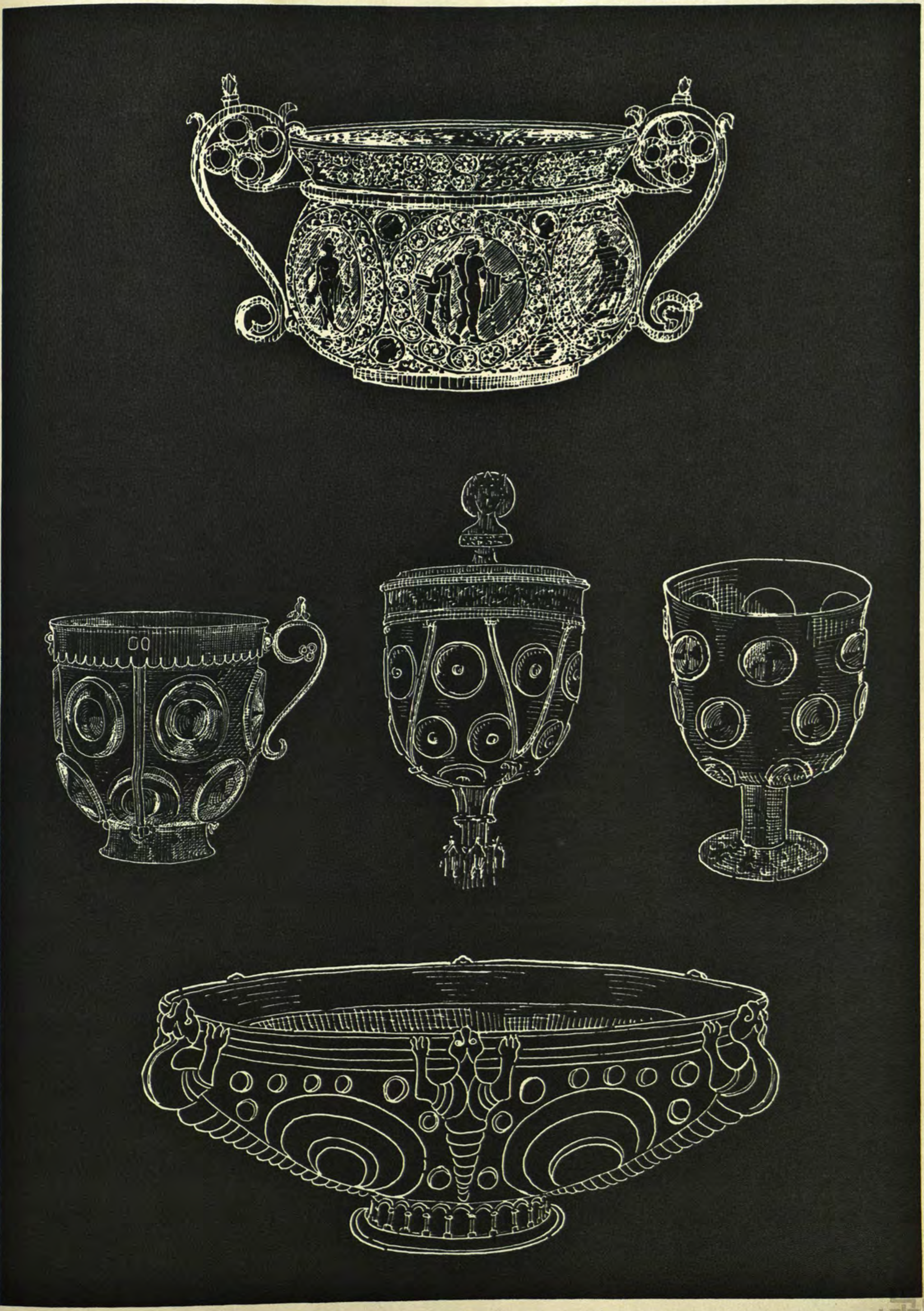
60.—61. Samples of Celtic Glass in Bohemia and Moravia from the First Century A. D.: 1. Millefiori Beads, Found at Popovice near Rajhrad. 2. Fragments of Cobalt-Glass Bracelets, with Fired Decorations, Found at Stradonice in Central Bohemia. 3. Cobalt-Glass Bracelet, Decorated With a Waving, Yellow Line. Found at Pesohlávky in Moravia. (No. 1, 3, in the Moravian Museum; no. 2. in the National Museum in Prague.) Glass Plate Found in the Grave of a Slav Nobleman near Kolín on the R. Elbe. End of the 9th or Beginning of the 10th Century. Moss-Green. (National Museum in Prague.)



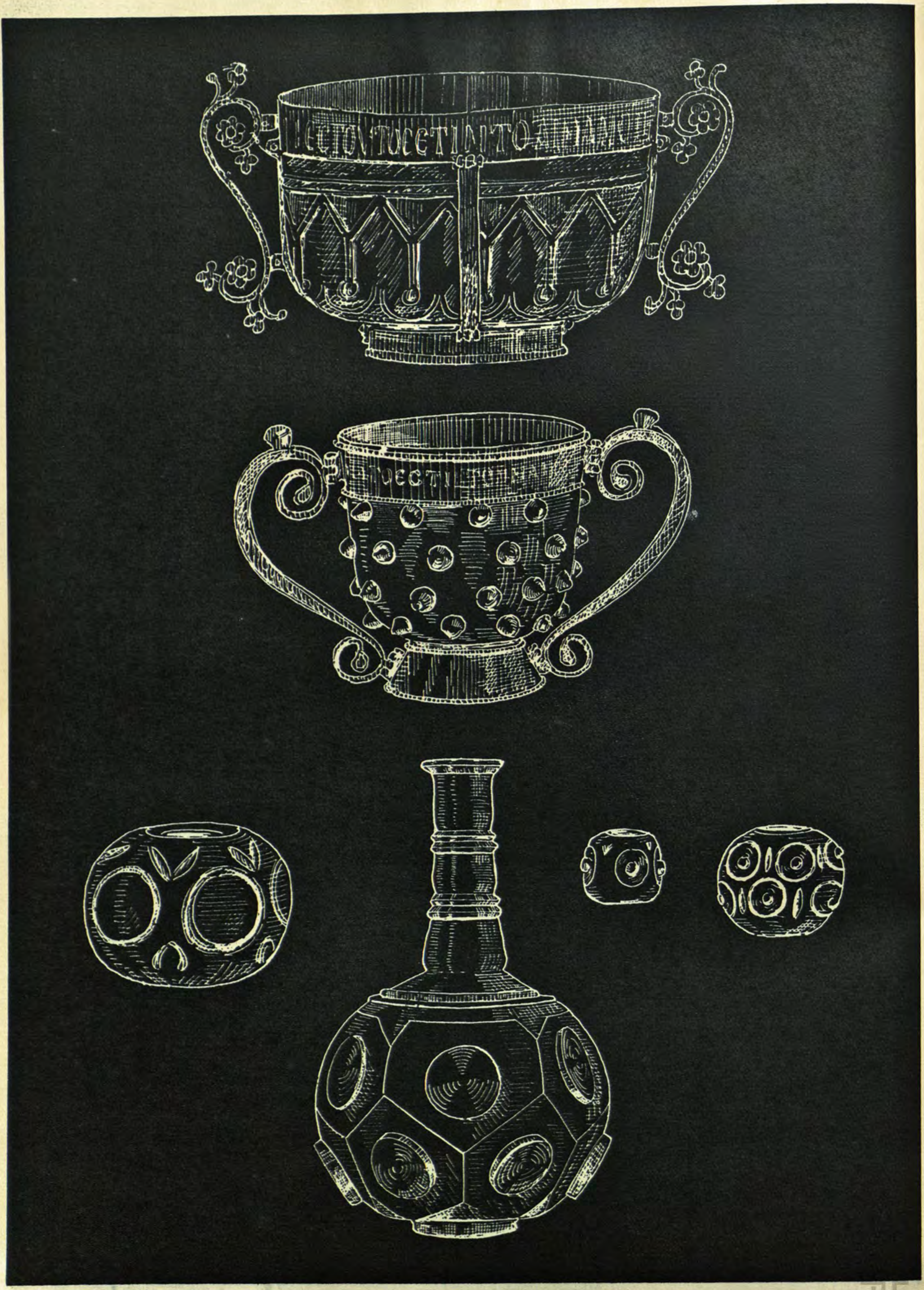
62. *Frankish Beaker, 5th—8th Cent.*

63. *Frankish Goblets from the 6th Cent. Found at Nieder-Breisig. (PACM)*

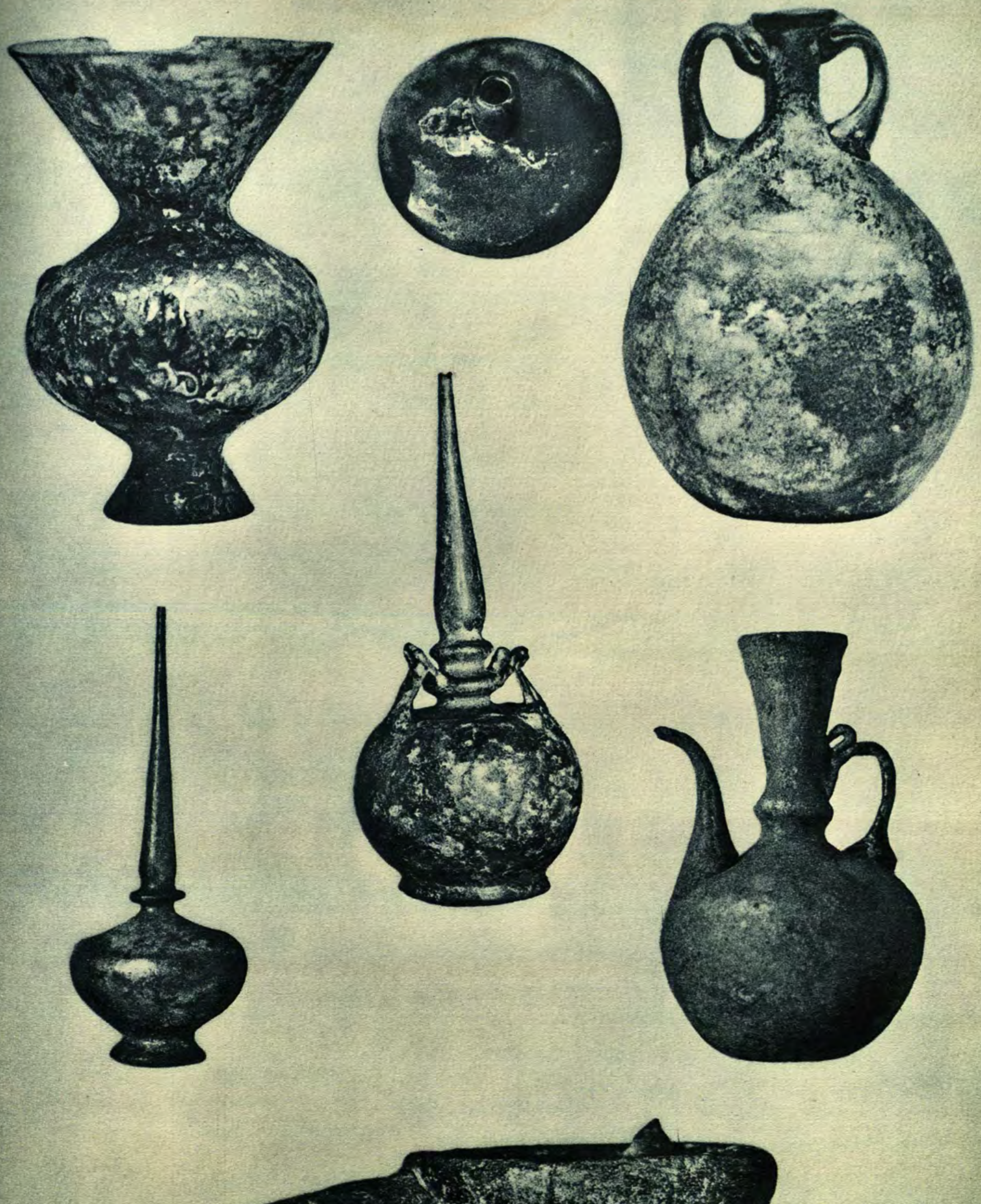




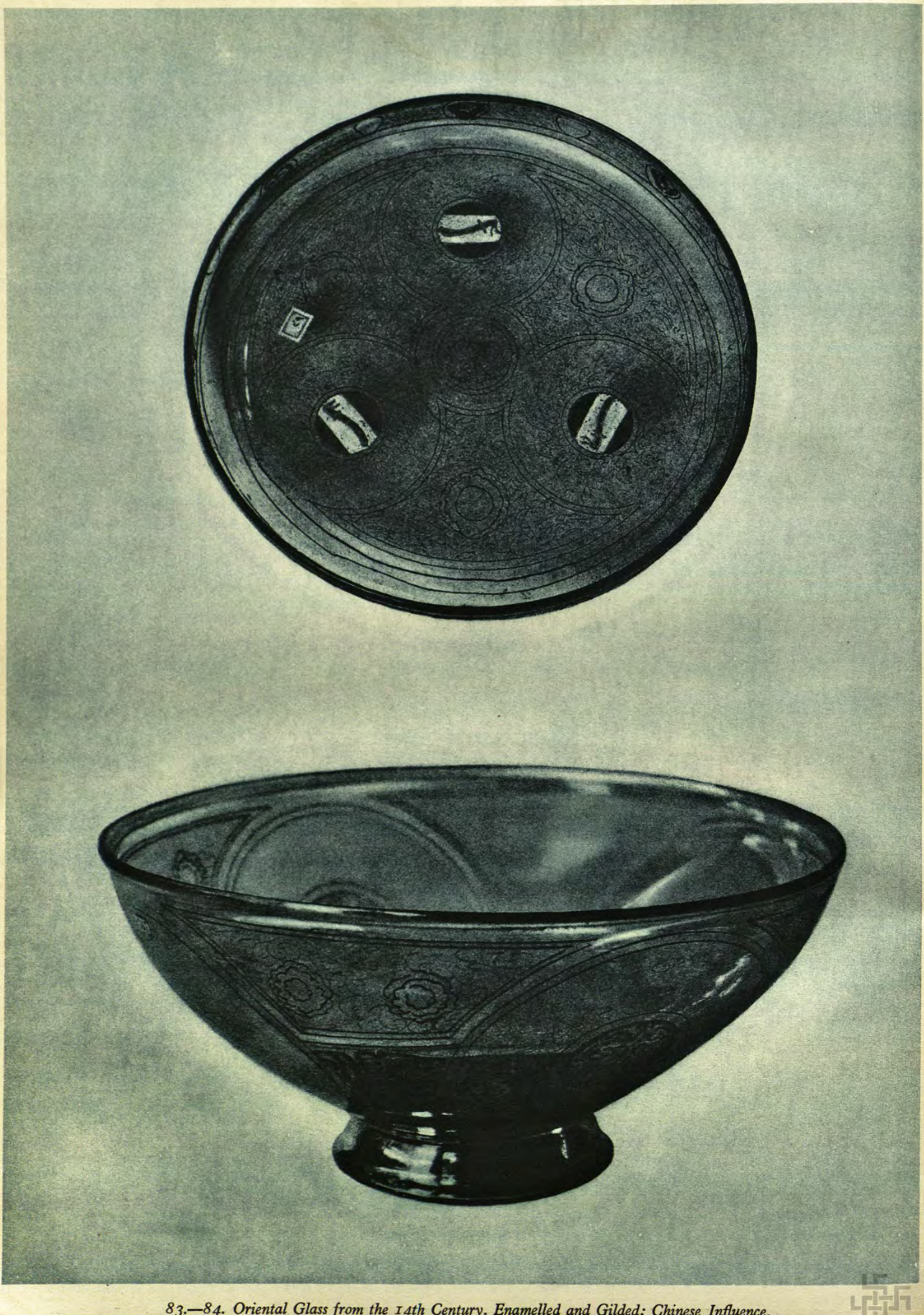
64.—69. *Byzantine Painted and Engraved Glass. (C. J. Lamm.)*



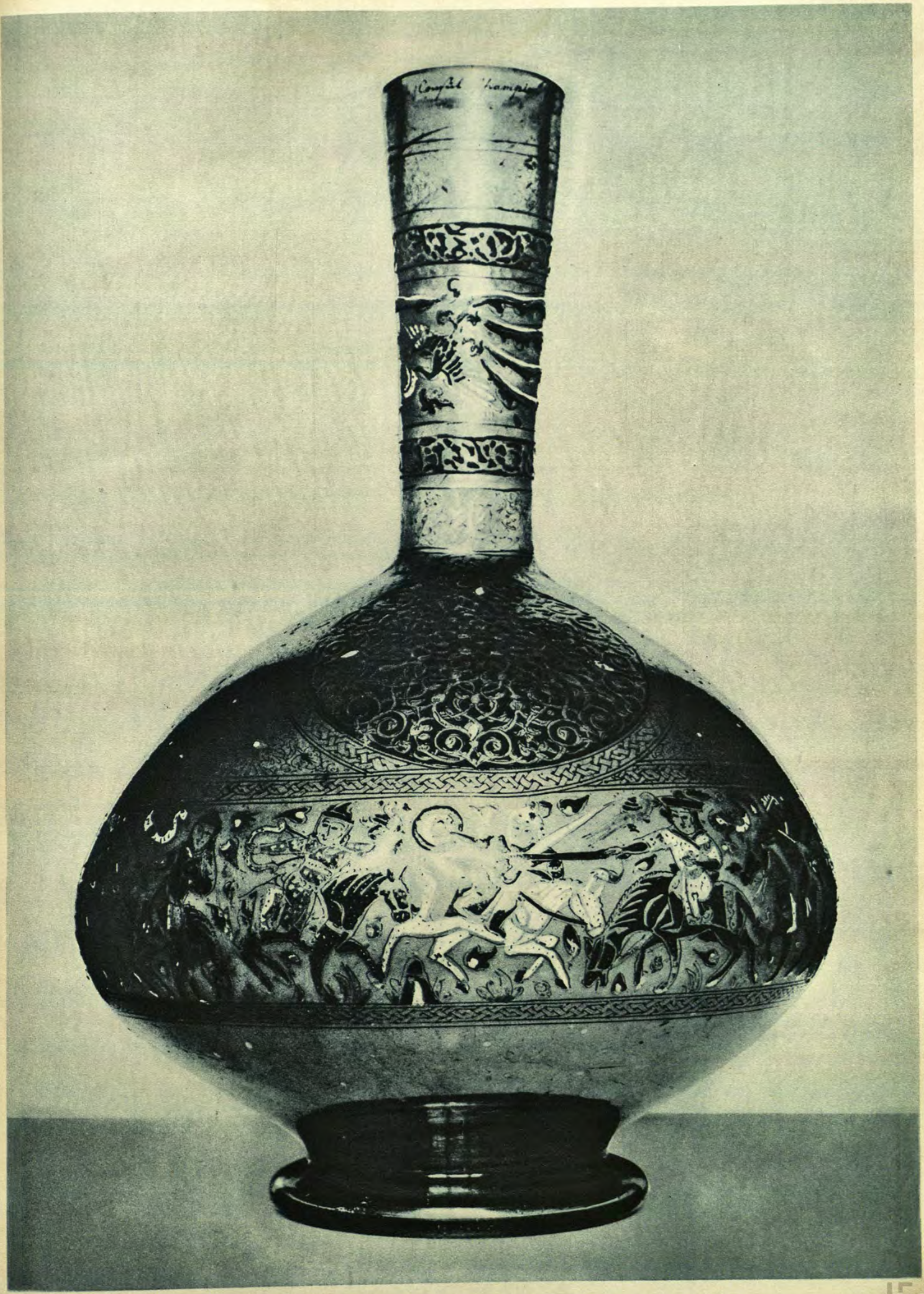
70.—75. Byzantine Cut Glass. (C. J. Lamm.)



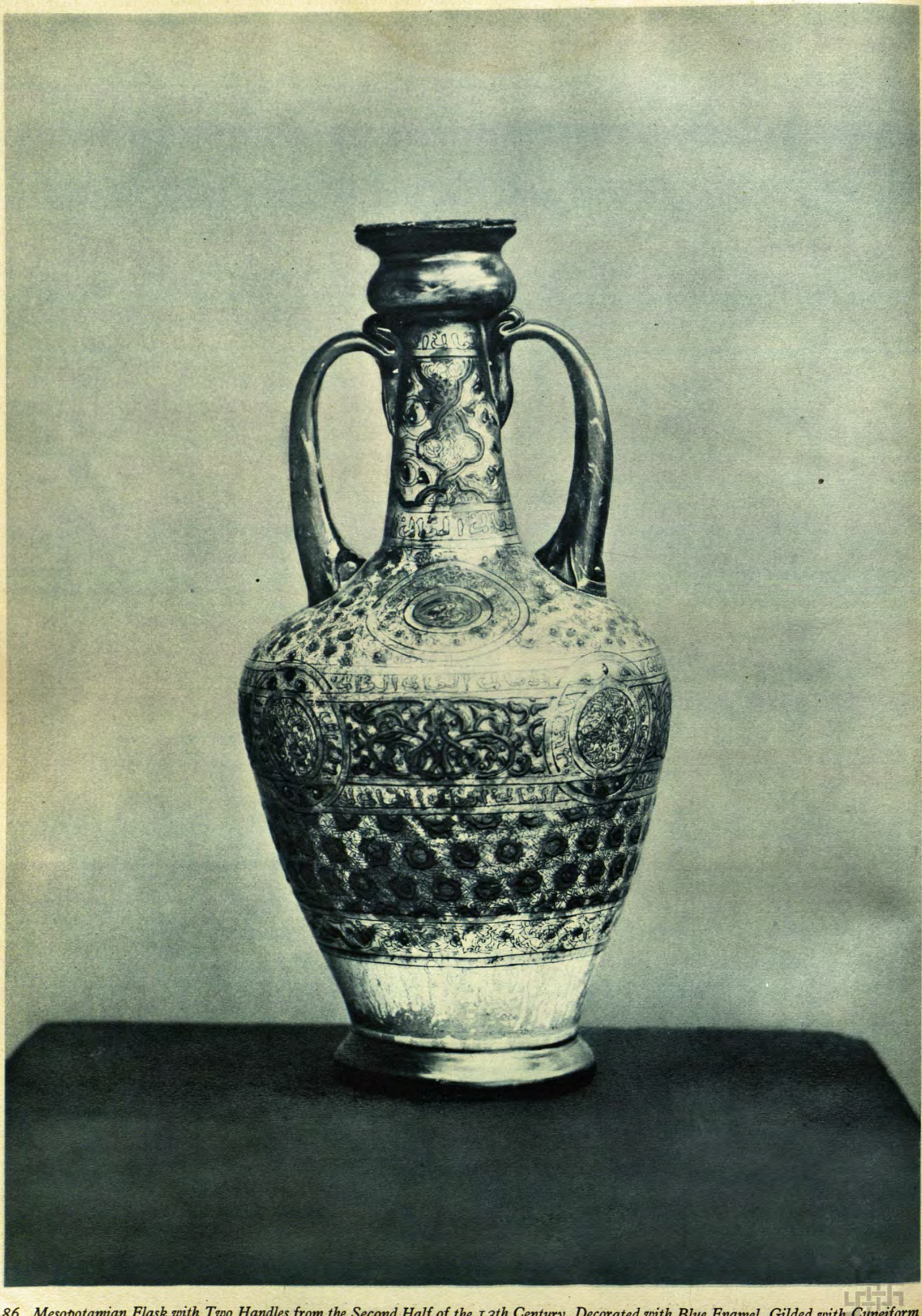
76.—82. Eastern Glass Without Decorations, in the Museums at Kiev, Toledo, Vienna and Constantinople. (C. J. Lamm.)



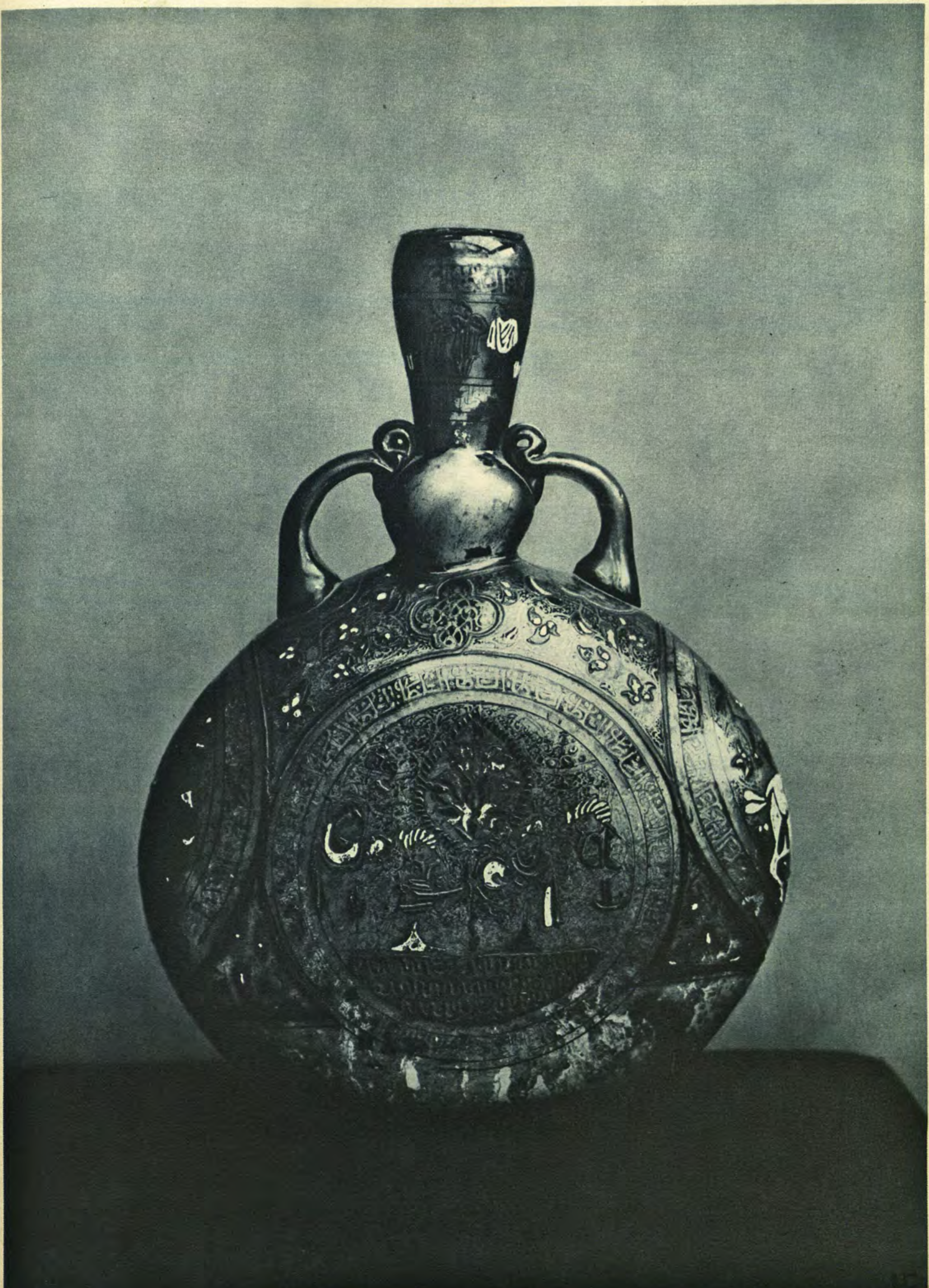
83.—84. Oriental Glass from the 14th Century. Enamelled and Gilded; Chinese Influence.



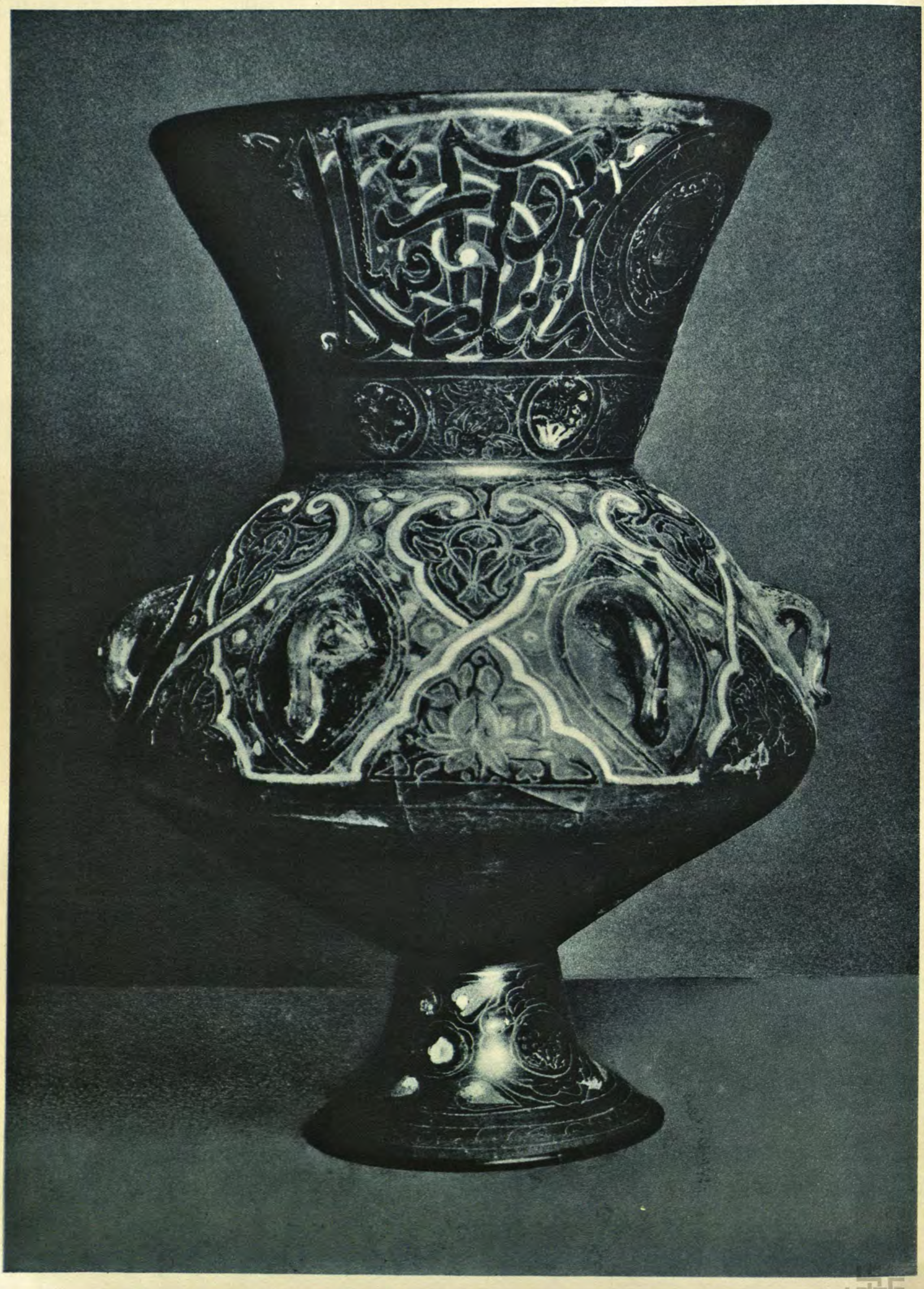
85. Magnificent Enamel and Gilt-Painted Flask, Influenced by Chinese Art. 14th Cent.



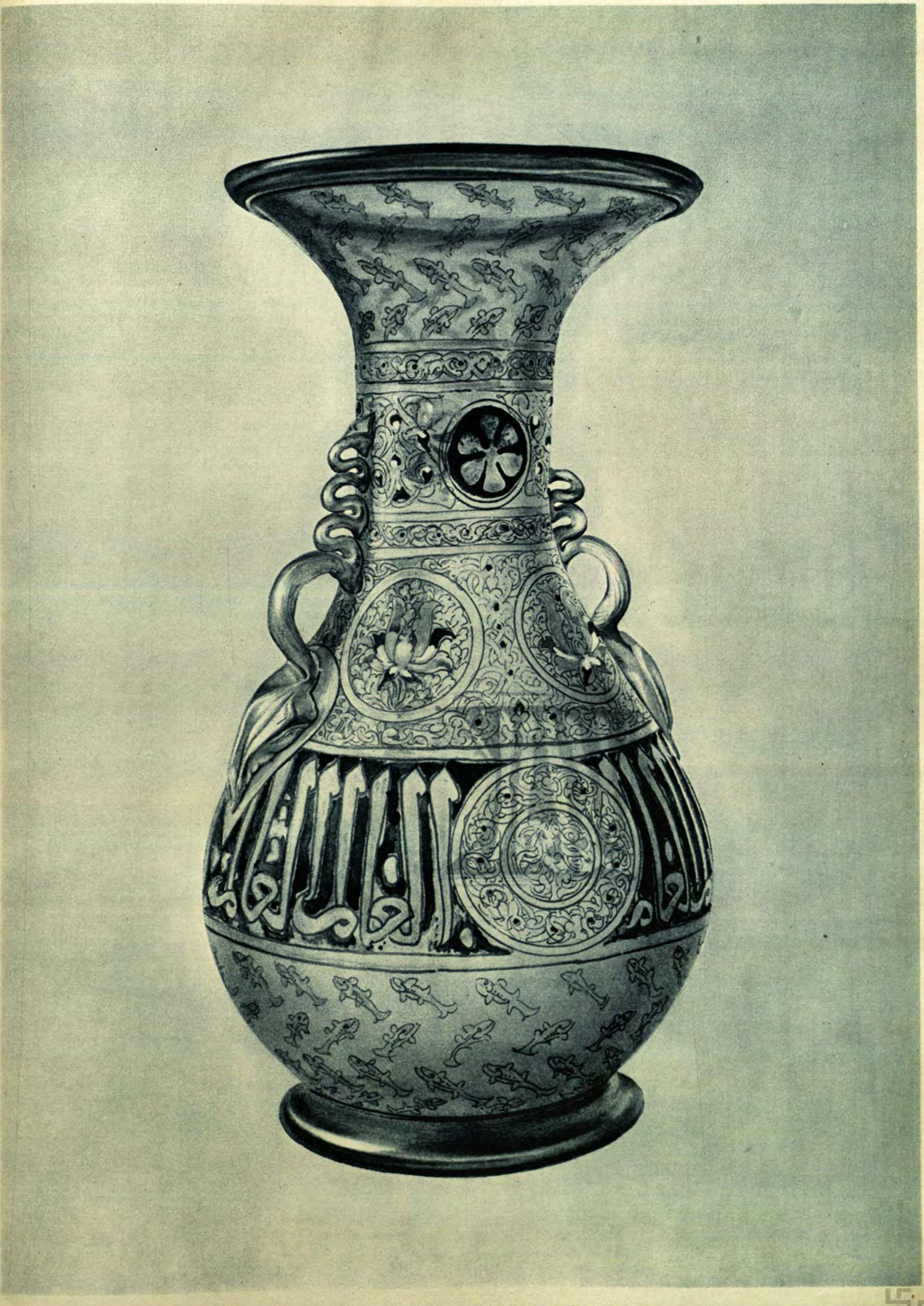
86. *Mesopotamian Flask with Two Handles from the Second Half of the 13th Century. Decorated with Blue Enamel, Gilded with Cuneiform Writing. (Vienna)*



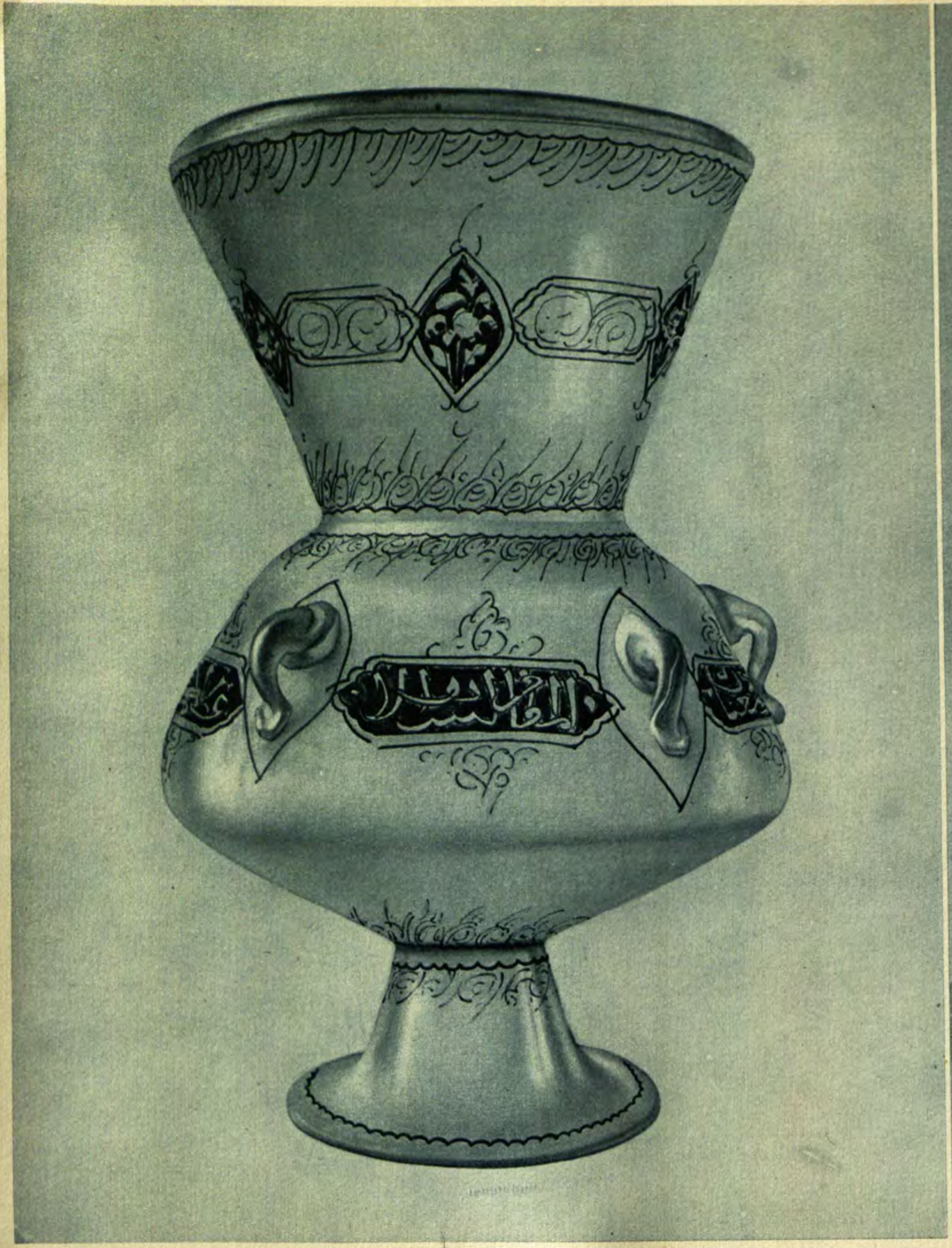
87. *Early Medieval, Richly Gilded Flask with Coloured Enamelled Scenes from the Life of the Saracenes. (Vienna)*



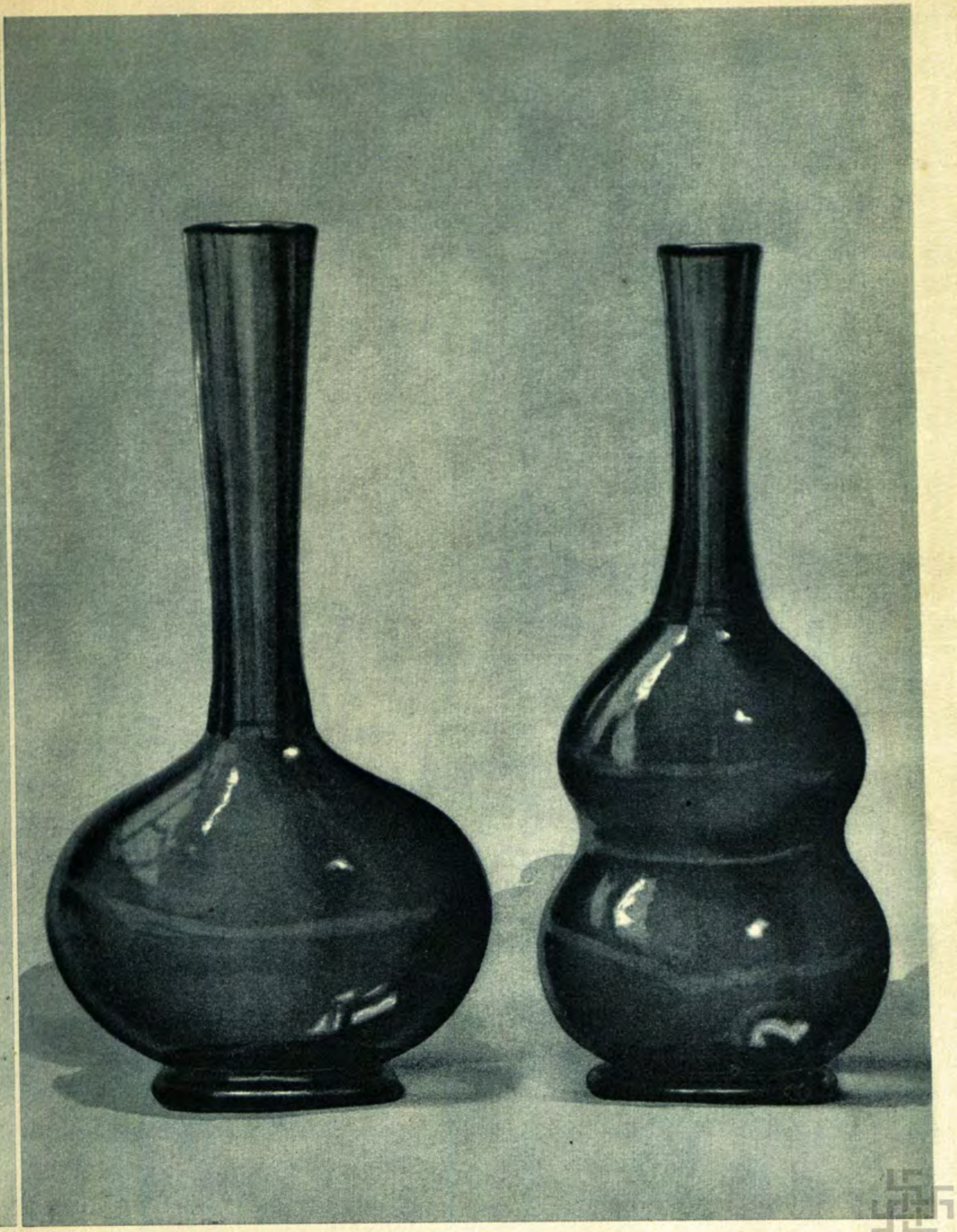
88. *Gilded and Enamelled Lamp from a Mosque. Chinese Influence, 14th Cent.*



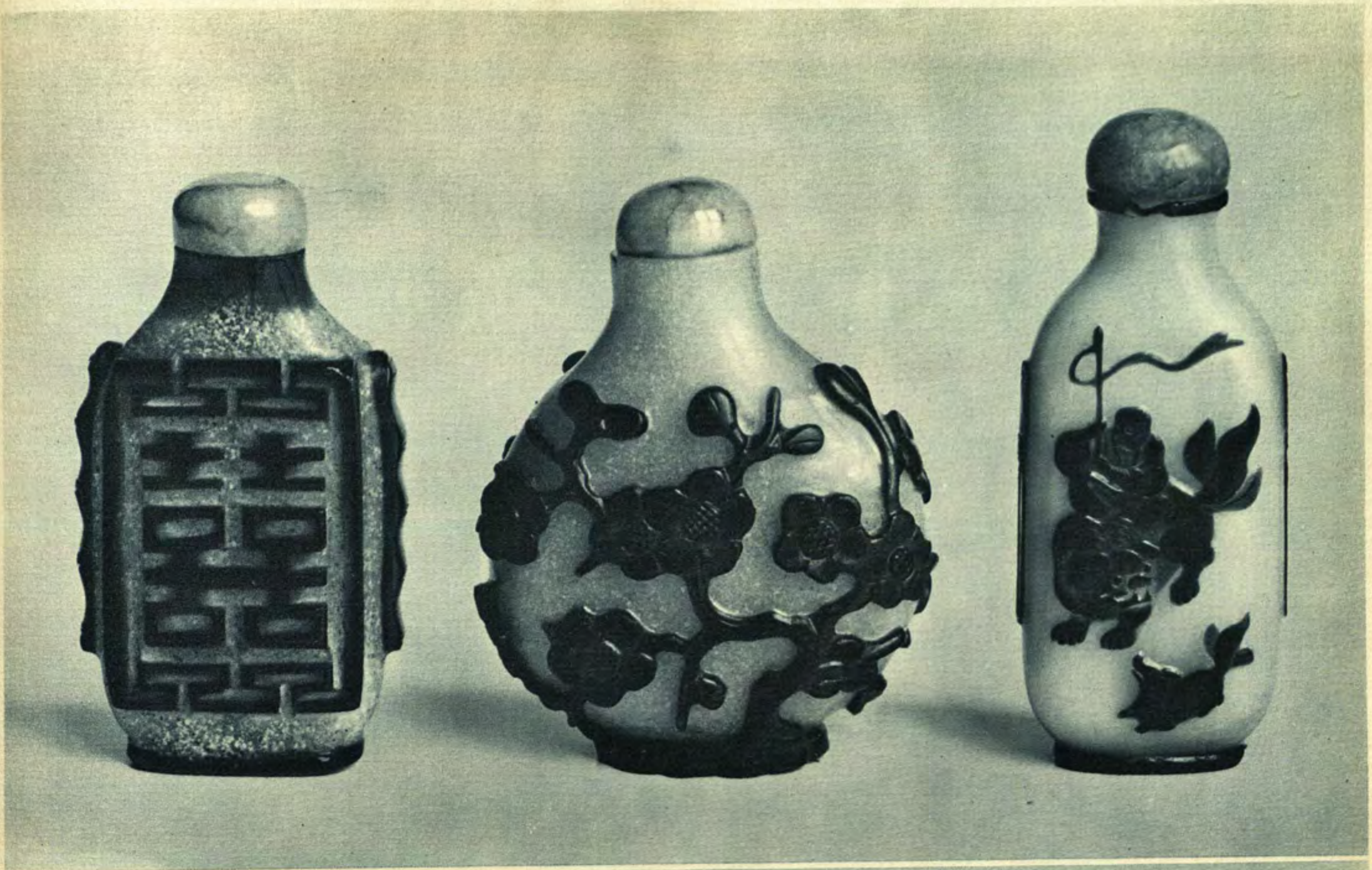
89. Magnificent Enamelled and Gilded Vase from Cairo.

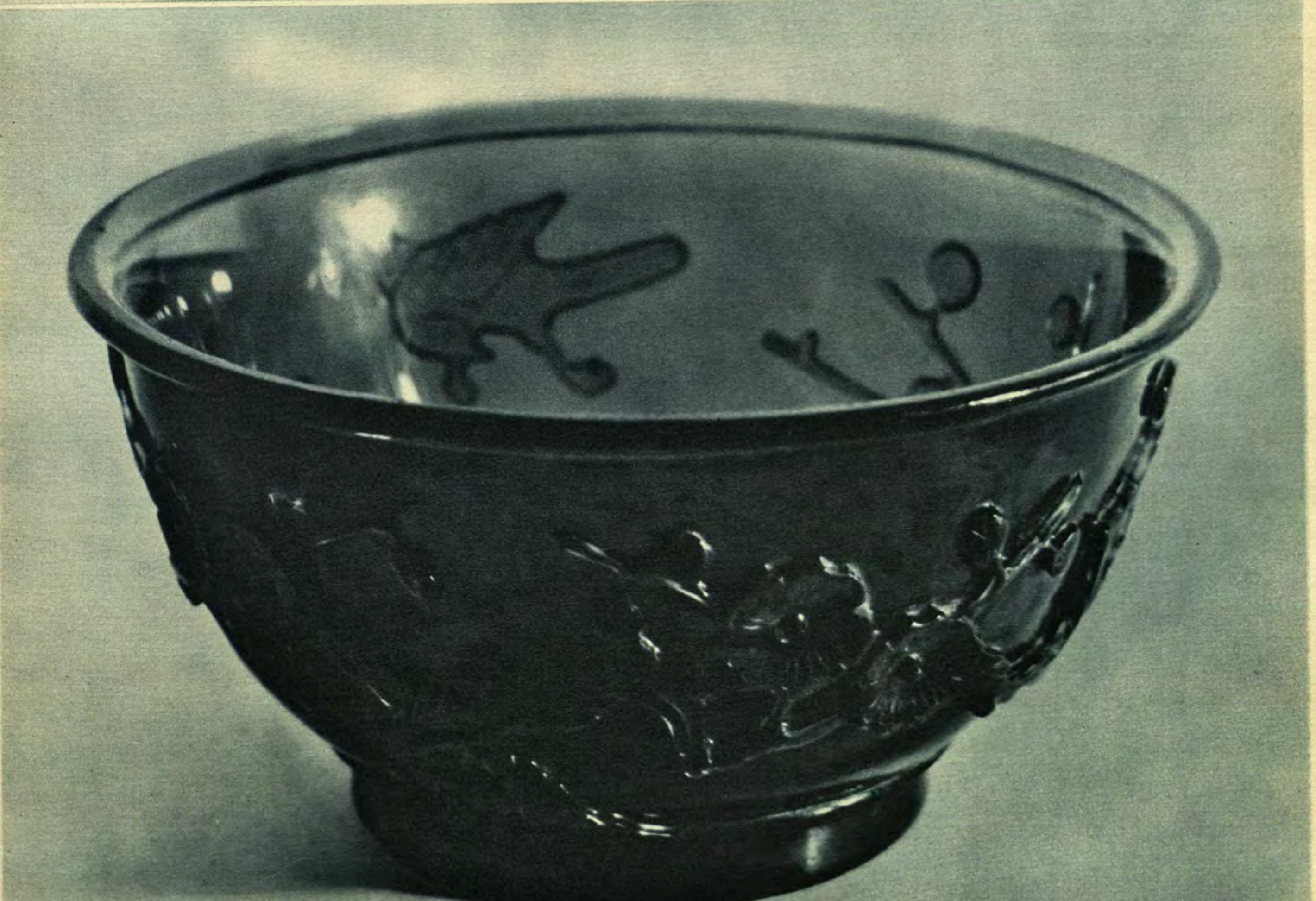


90. *Arab Lamp in the Cairo Museum.*

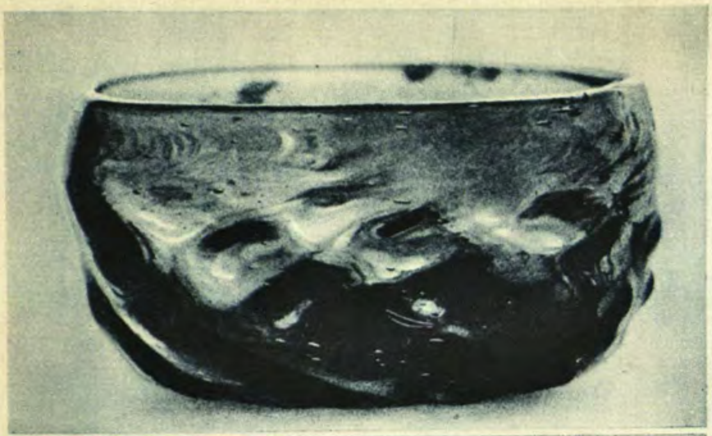


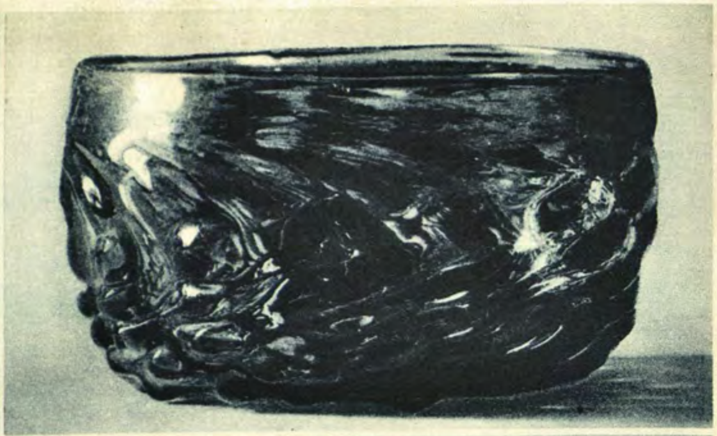
91. *Green Indian Glass from Putna, Bengal.*

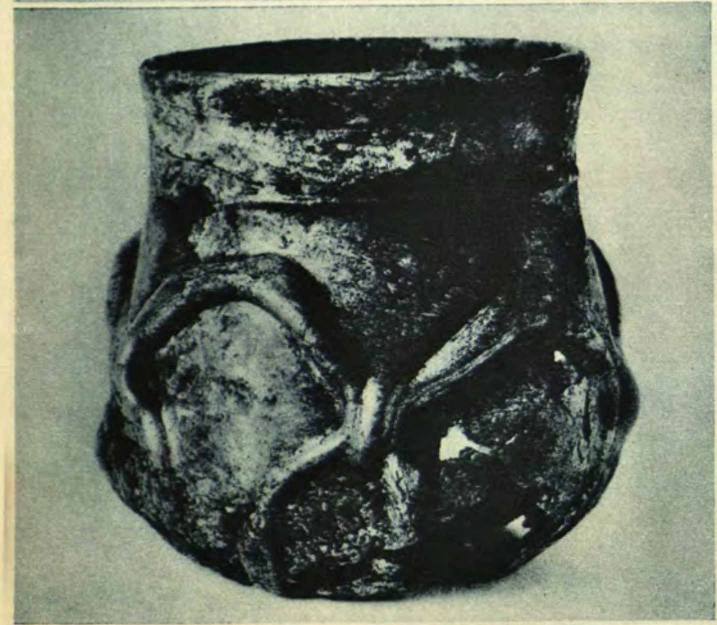


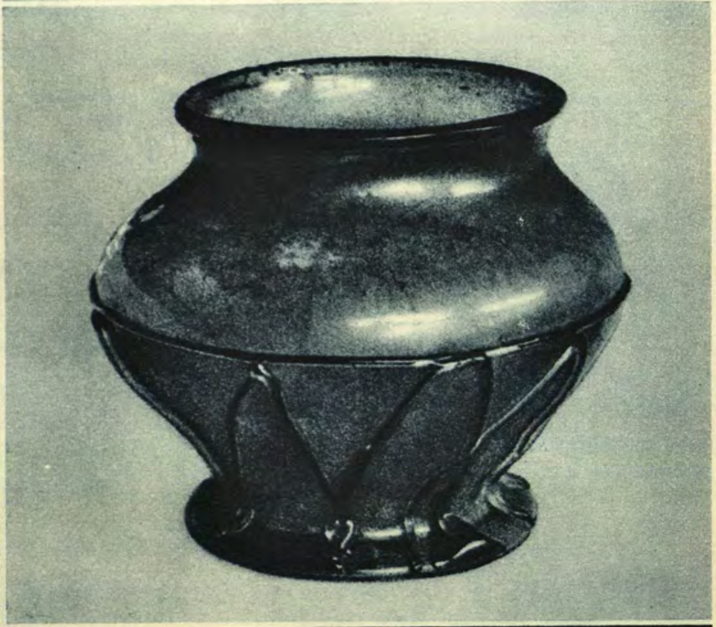


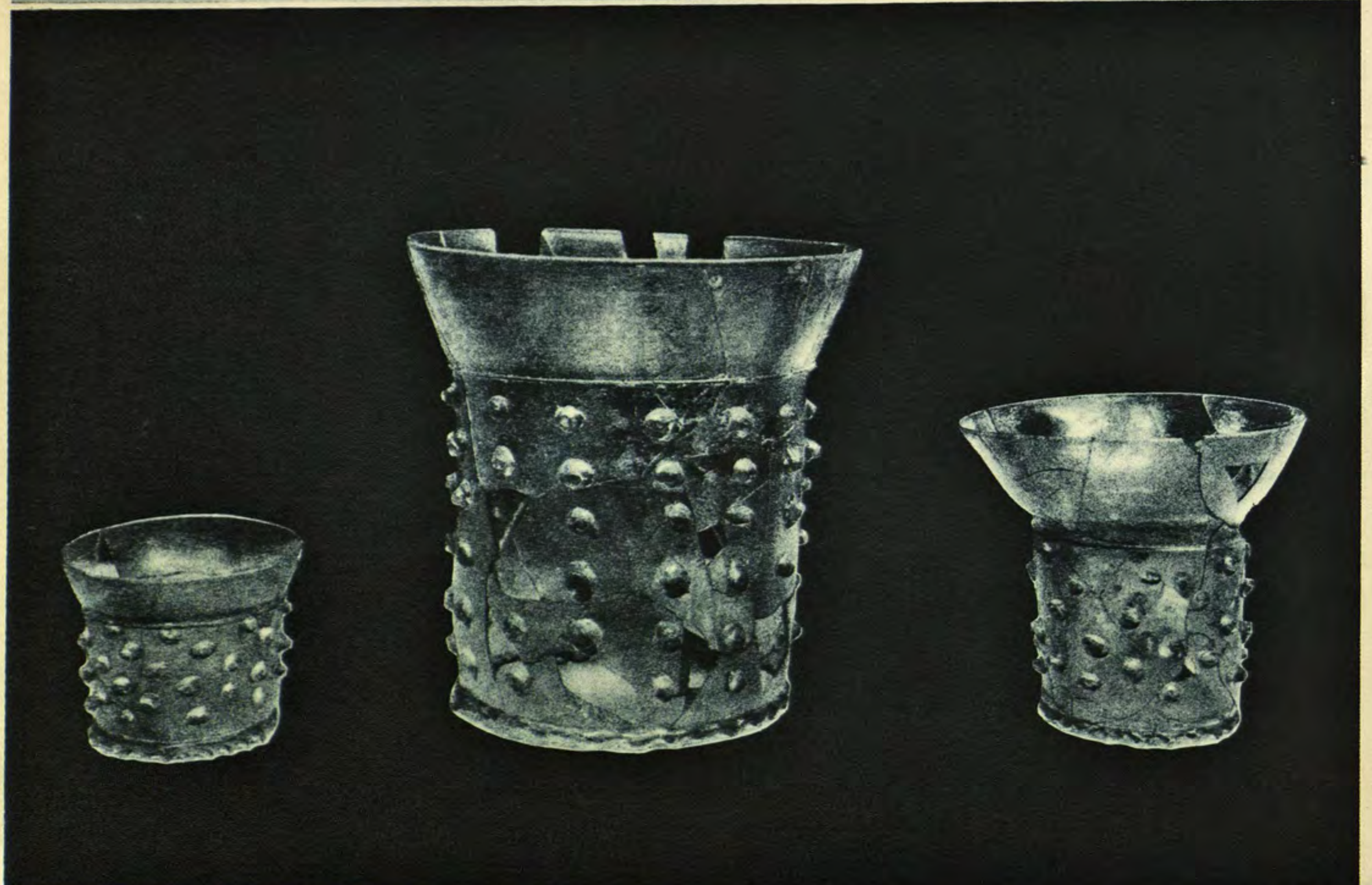
92. *Chinese Tobacco Bottles of Cut "Cased"-Glass. 19th Cent. (PACM)* 93. *Plastically Cut Dish of "Gold-Ruby", Probably Chinese. (PACM)*



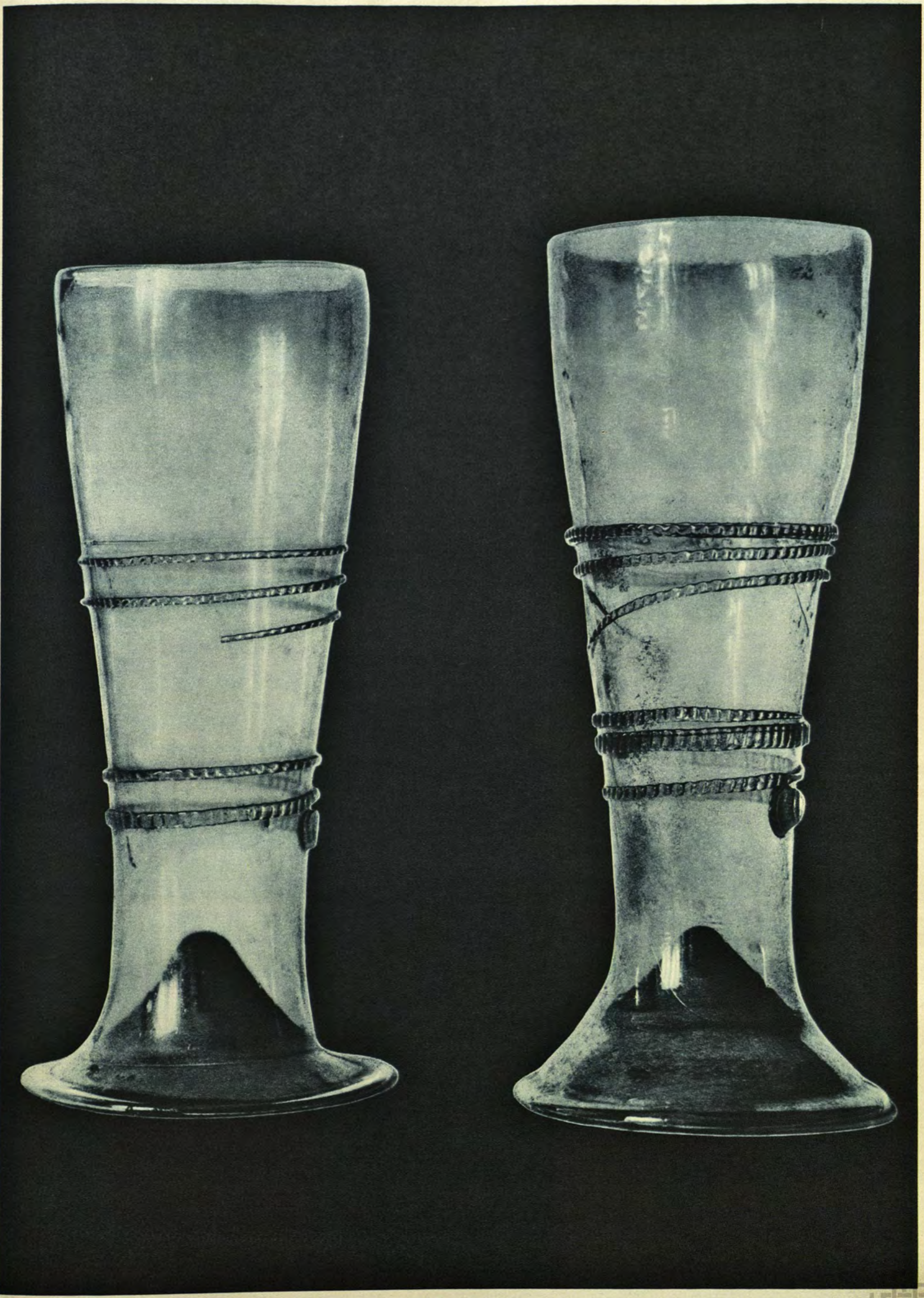




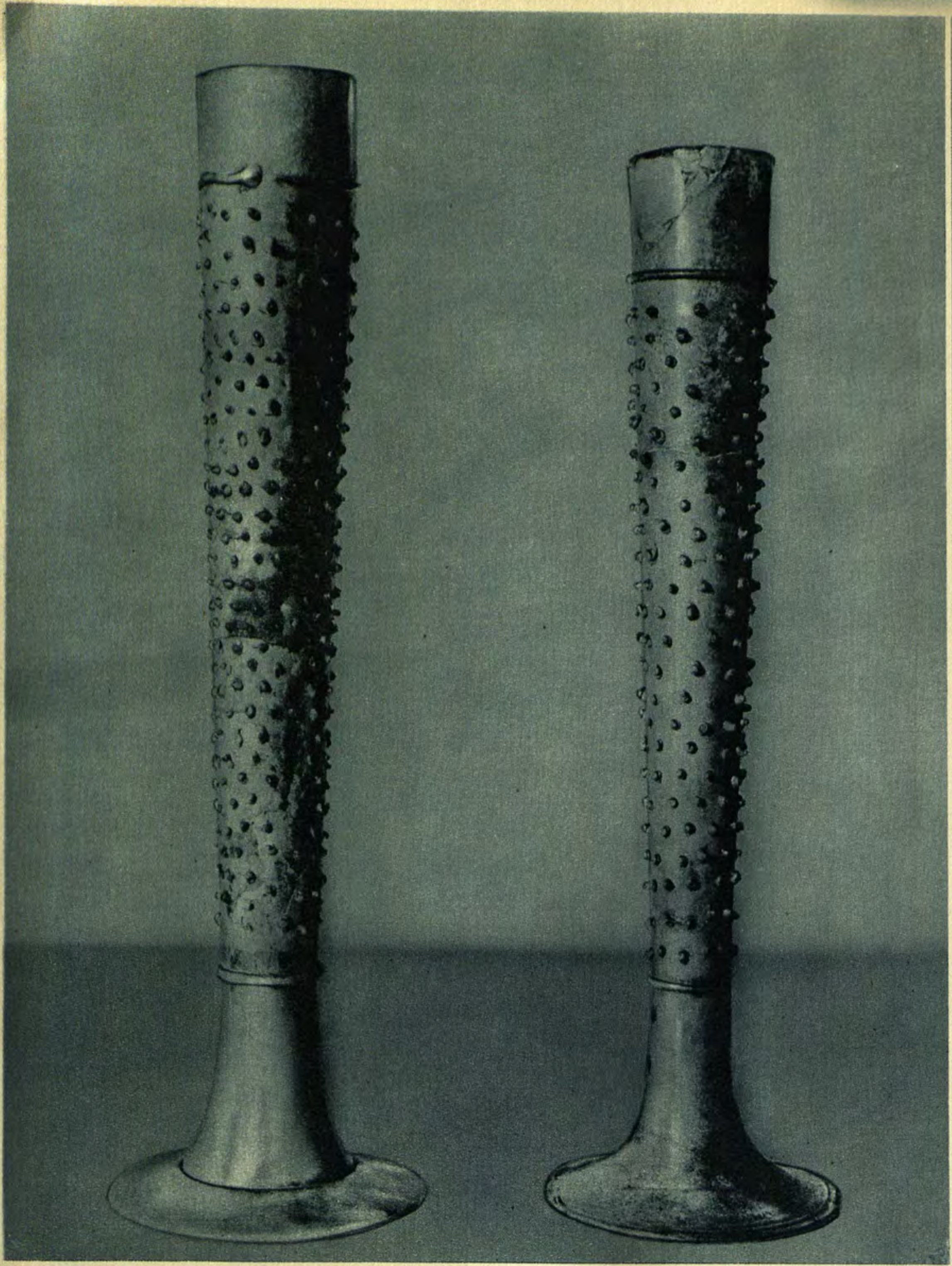




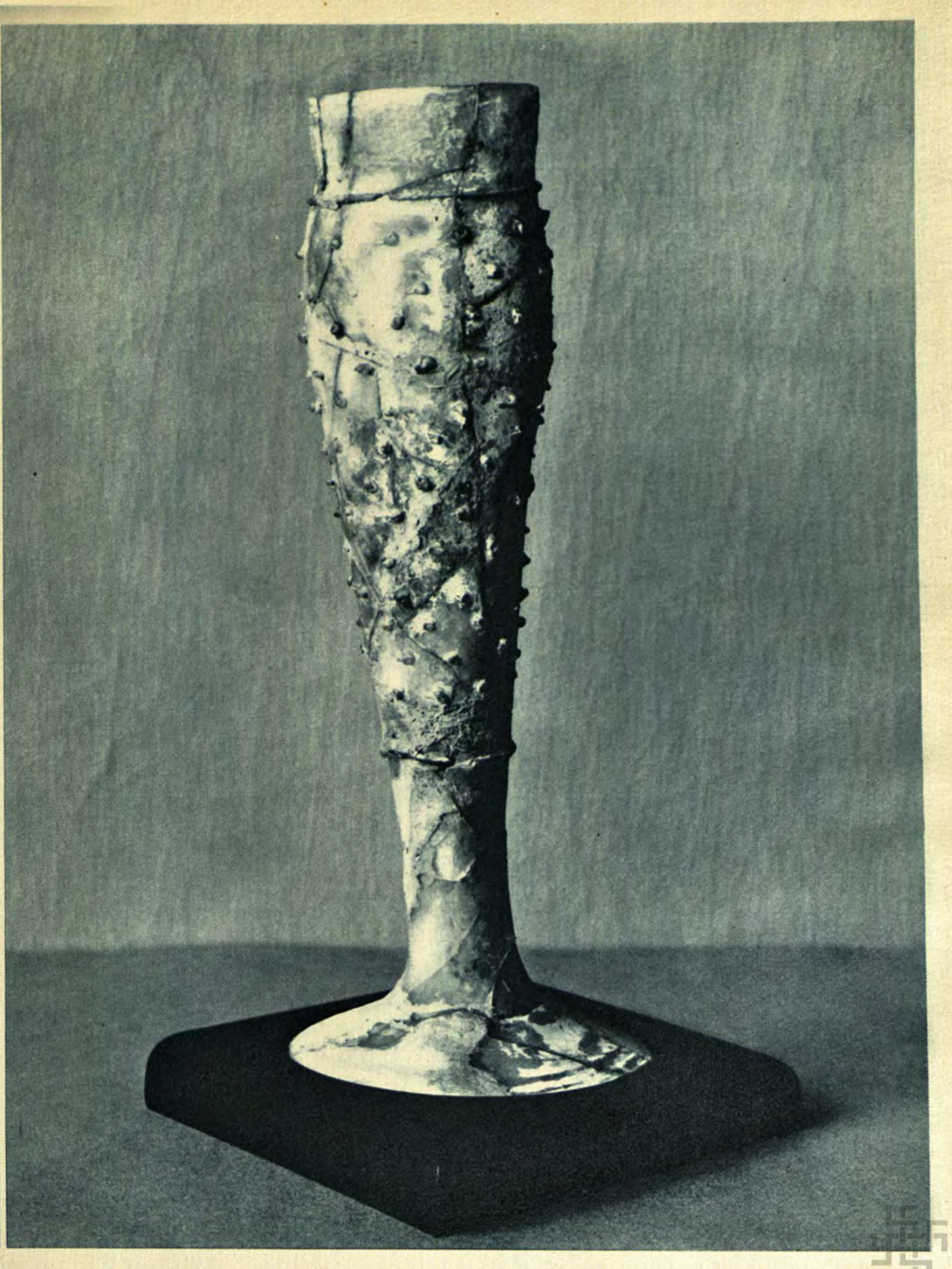
94.—95. "Forest-Glass" Beakers from the 14th Cent. 96. Small Drinking Vessel, Decorated with Thread-Glass. Found at Birke in Sweden. 9th Cent. May be Russian, Possibly from Kiev. 97. Small Drinking Vessel, Decorated with Thread-Glass. Swabian, "Head"-Shaped. End of the 13th Cent. Light Green. 98. Three Drinking Vessels with "Stuck-On" Decorations, 15th Cent.



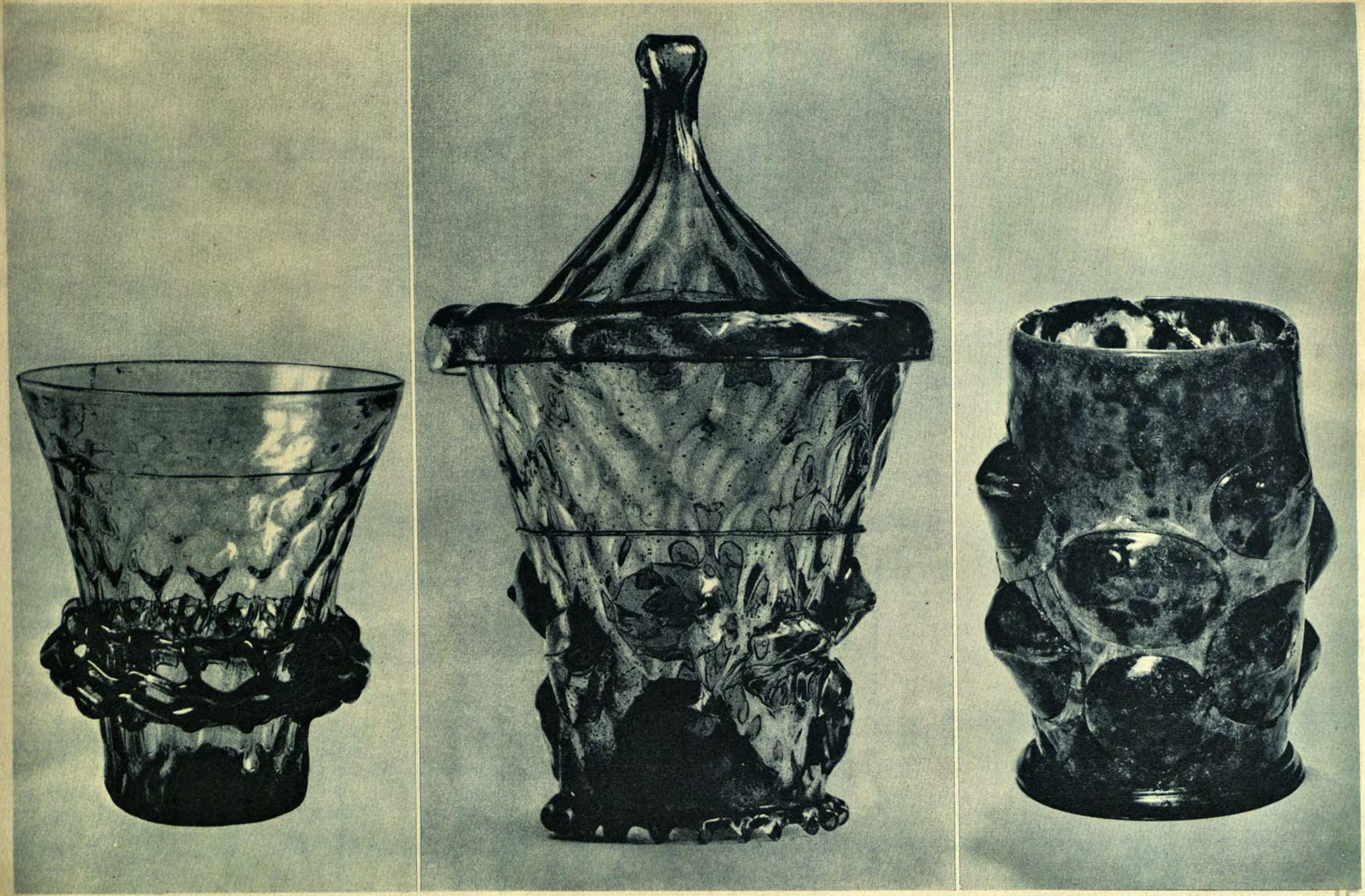
99.—100. Two Tall, Light Green Drinking Vessels Surrounded with Thread-Glass. 16th Cent.



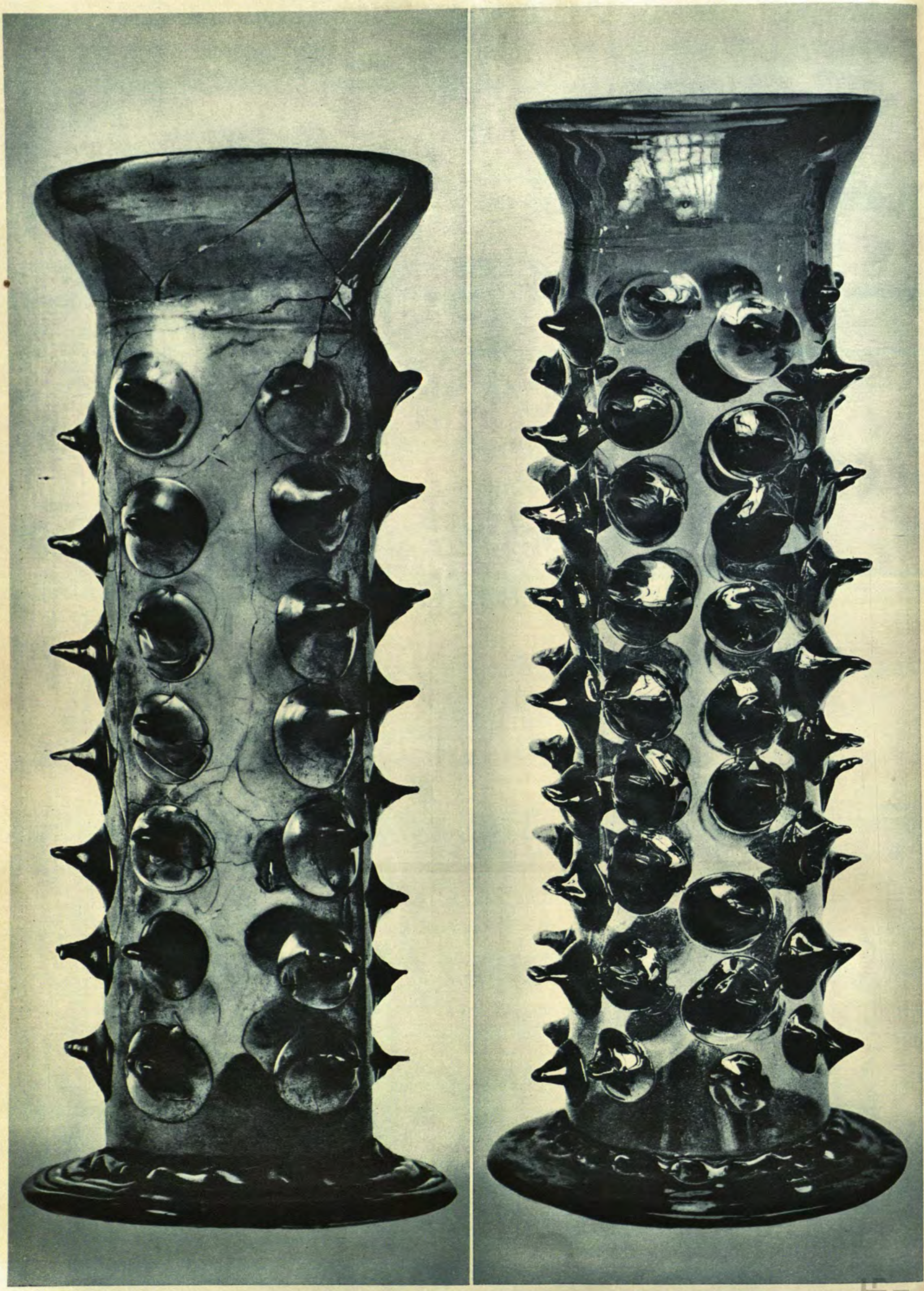
101.—102. Bohemian "Wart" Glasses Found in a House in the Old Town of Prague. End of the 14th Cent.



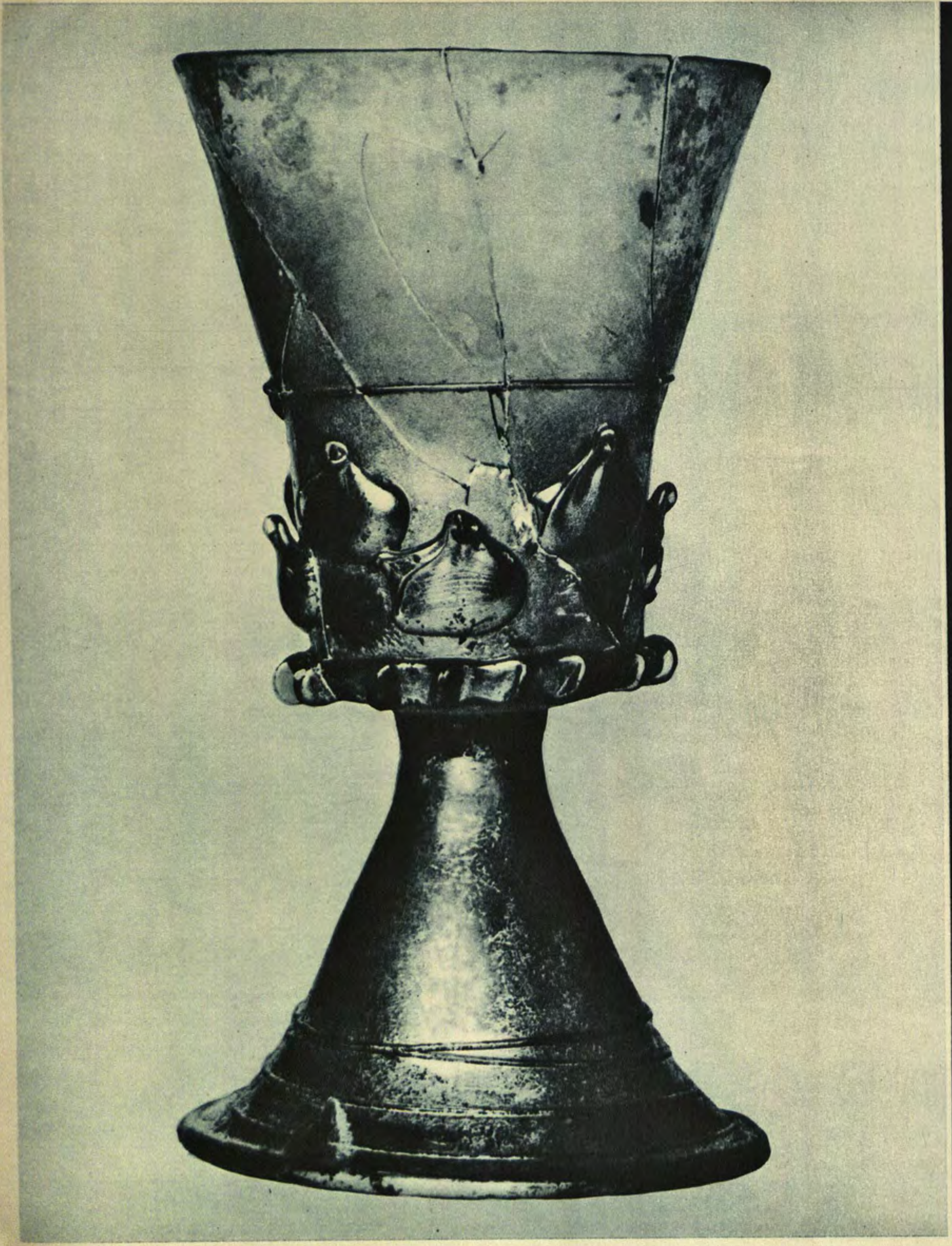
103. Bohemian Glass Beaker, Medieval Shape. Found at Sezimovo Ústí near Tábor, S. Bohemia. About 1400. (PACM)



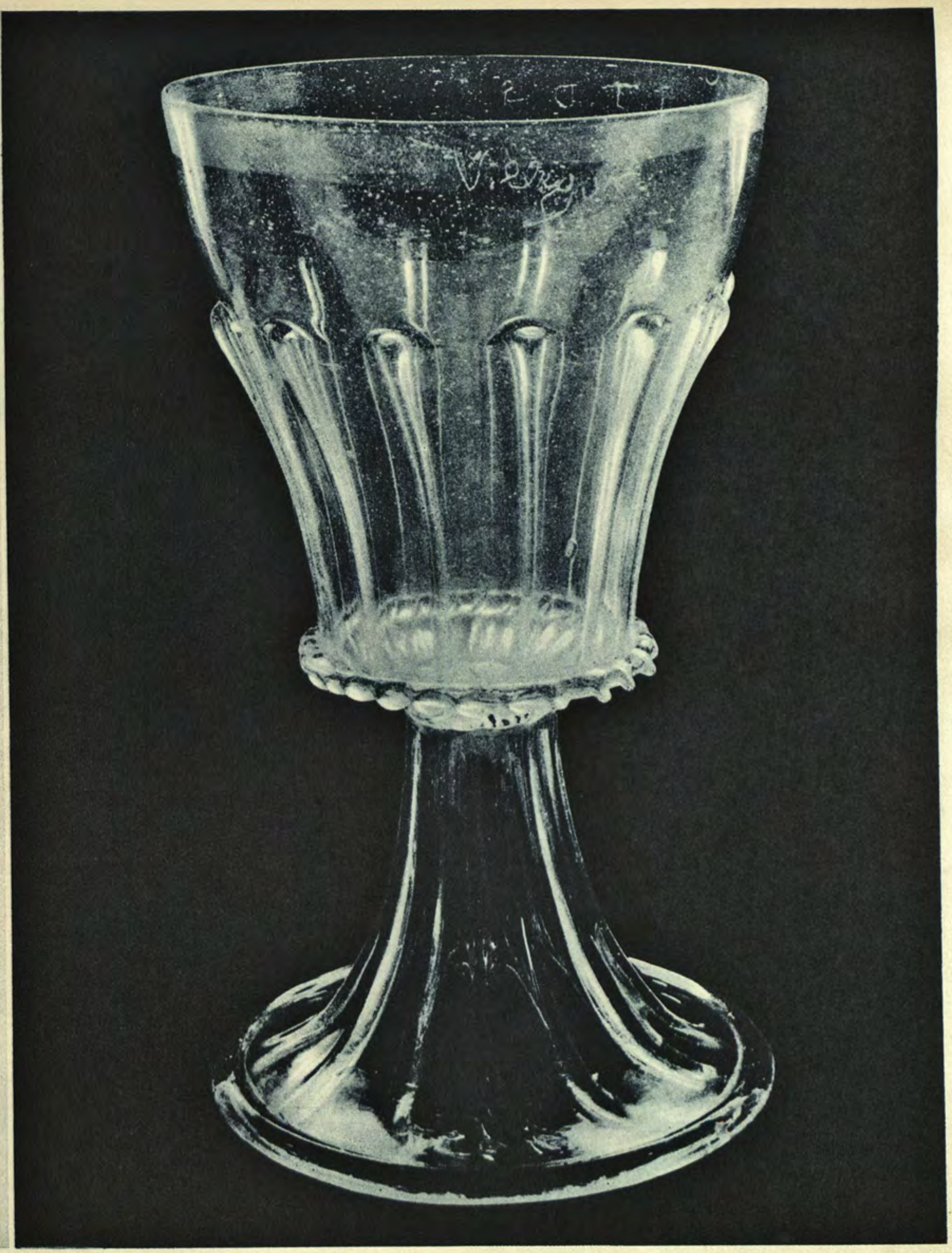
104.—105. "Optic" Glasses Decorated with Glass Threads, from the 13th Cent. 106. Bull's-Eye Drinking Vessels. Photo Brok, Prague.



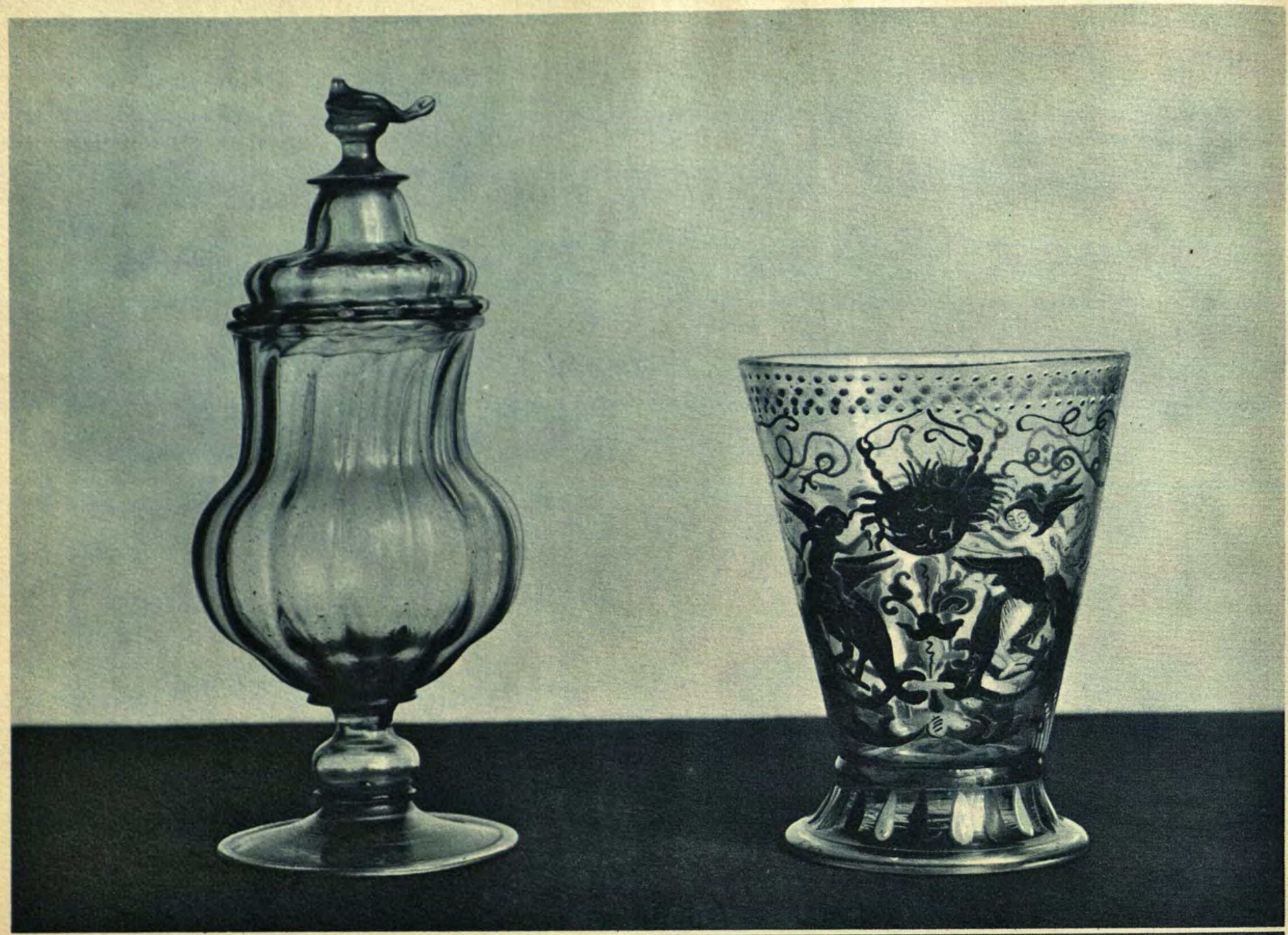
107.—108. Stick-Like "Hedgehog" Drinking Vessels from the 15th Cent.

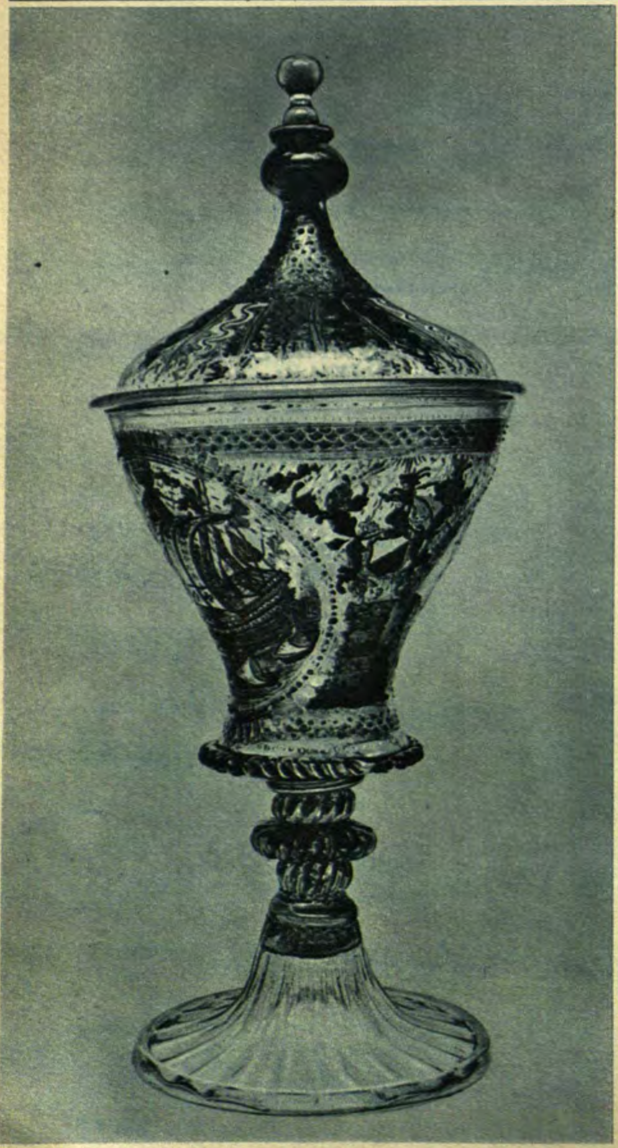


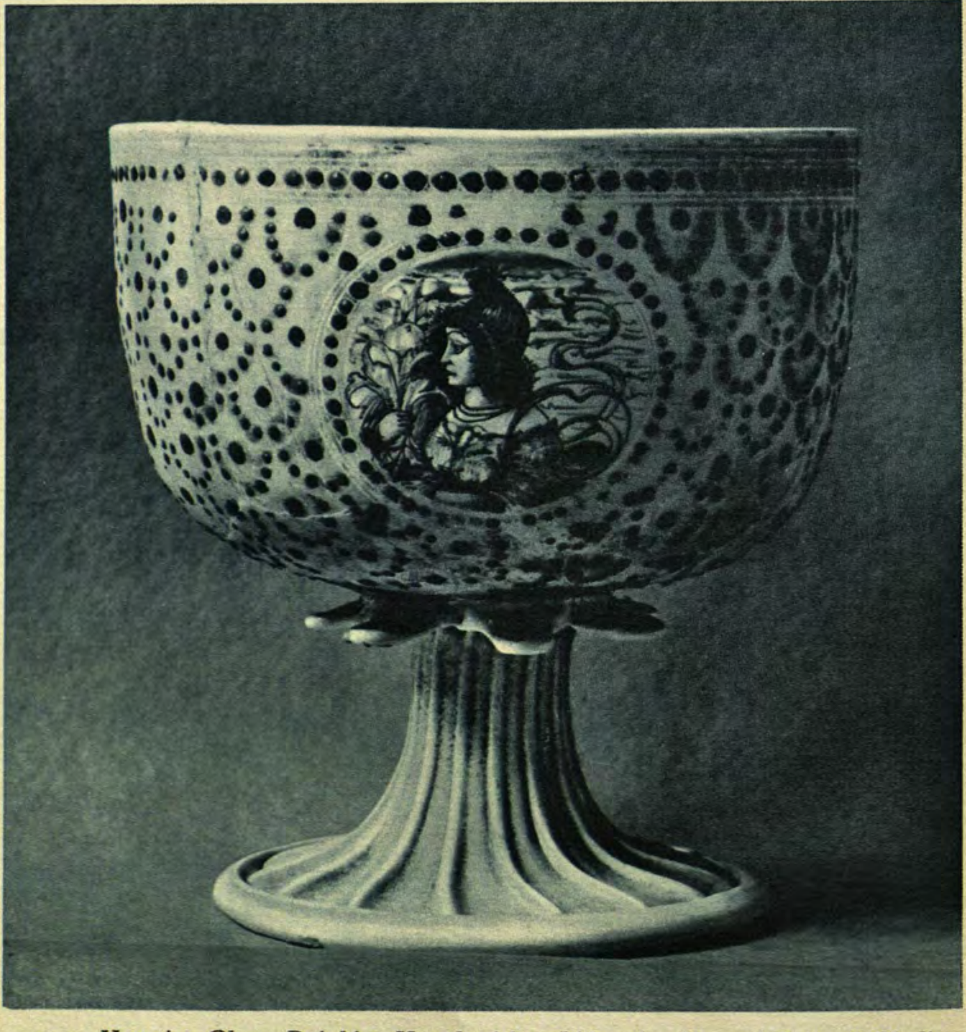
109. Drinking Vessel with "Stuck-On" Decorations. Second Half of the 16th Cent.



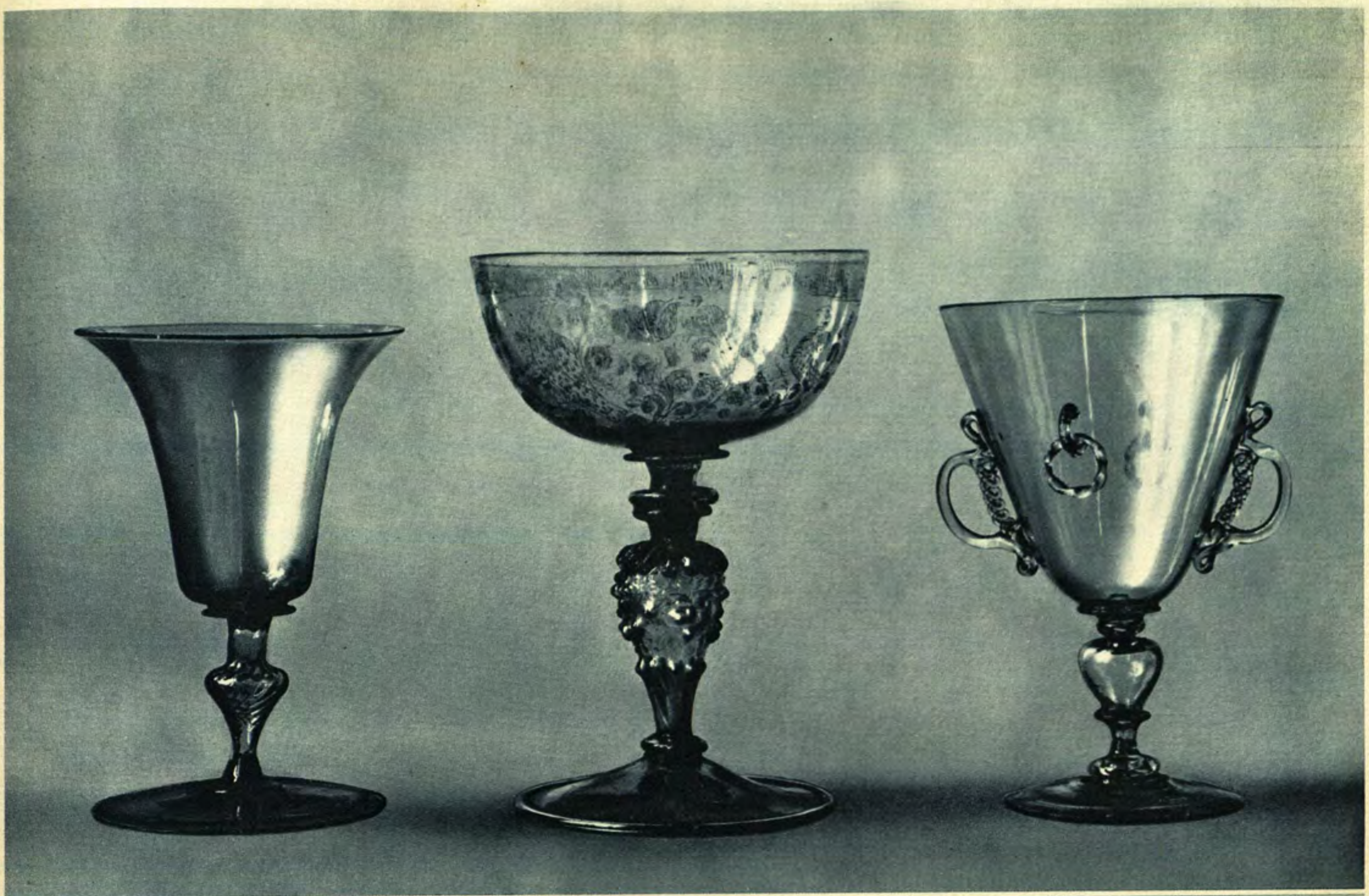
110. Venetian Drinking Vessel with Diamond Engravings. About 1500.

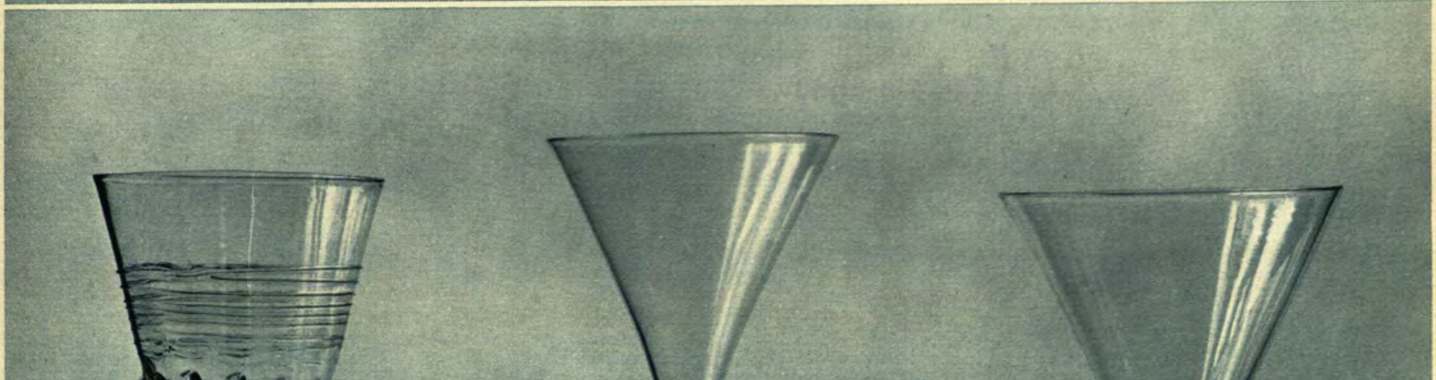




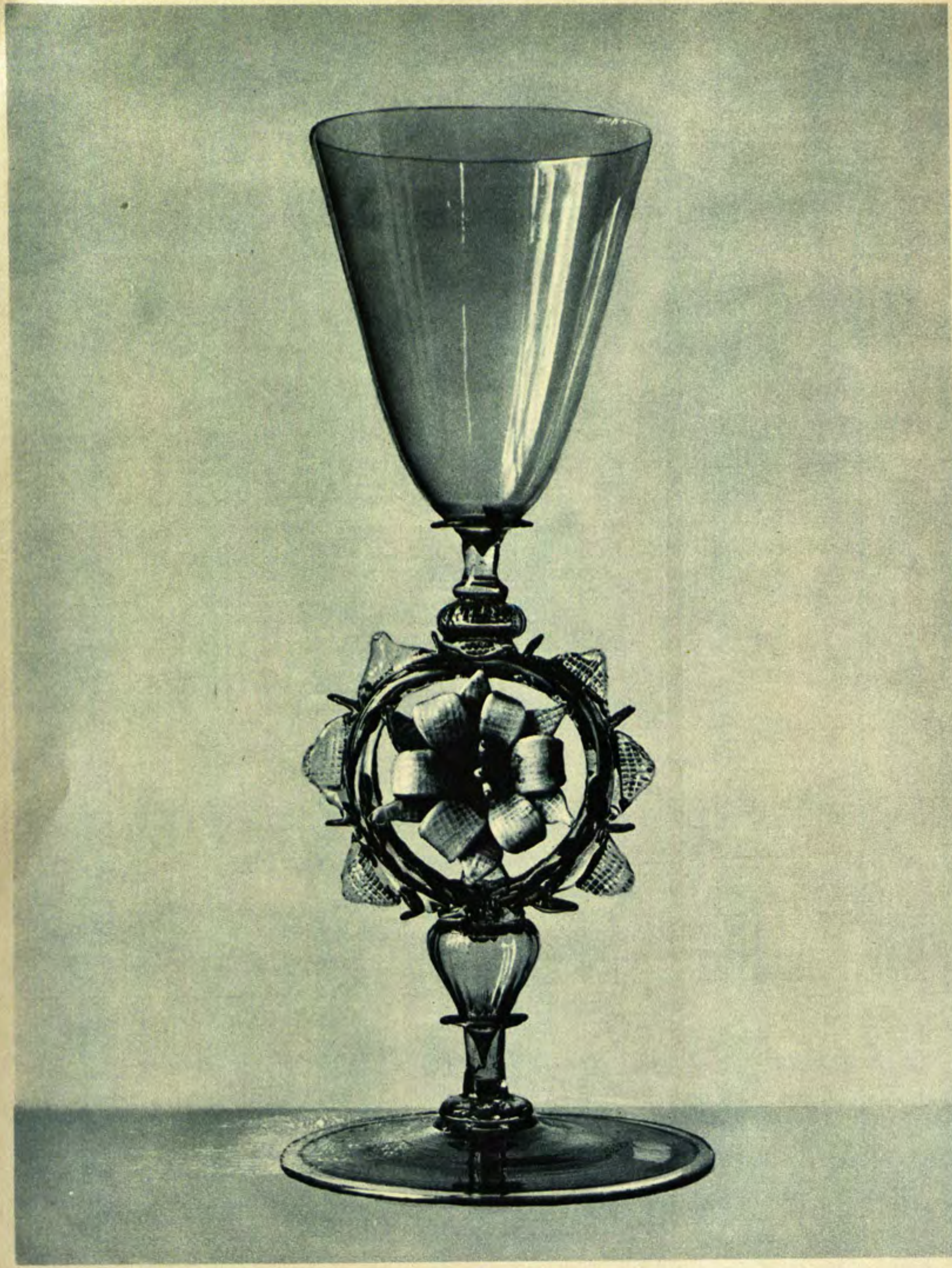


111. Venetian Glass: Drinking Vessel with a Lid and a Enamel-Painted Chalice. End of the 15th Cent. (PACM) 112. Georg Kopidlanský's Drinking Vessel, Enamel-Painted, Venice, End of the 15th Cent. 113. Milk-Glass Vessel. Enamel-Painted. Venice, End of the 15th Cent. (National Museum, Prague.)

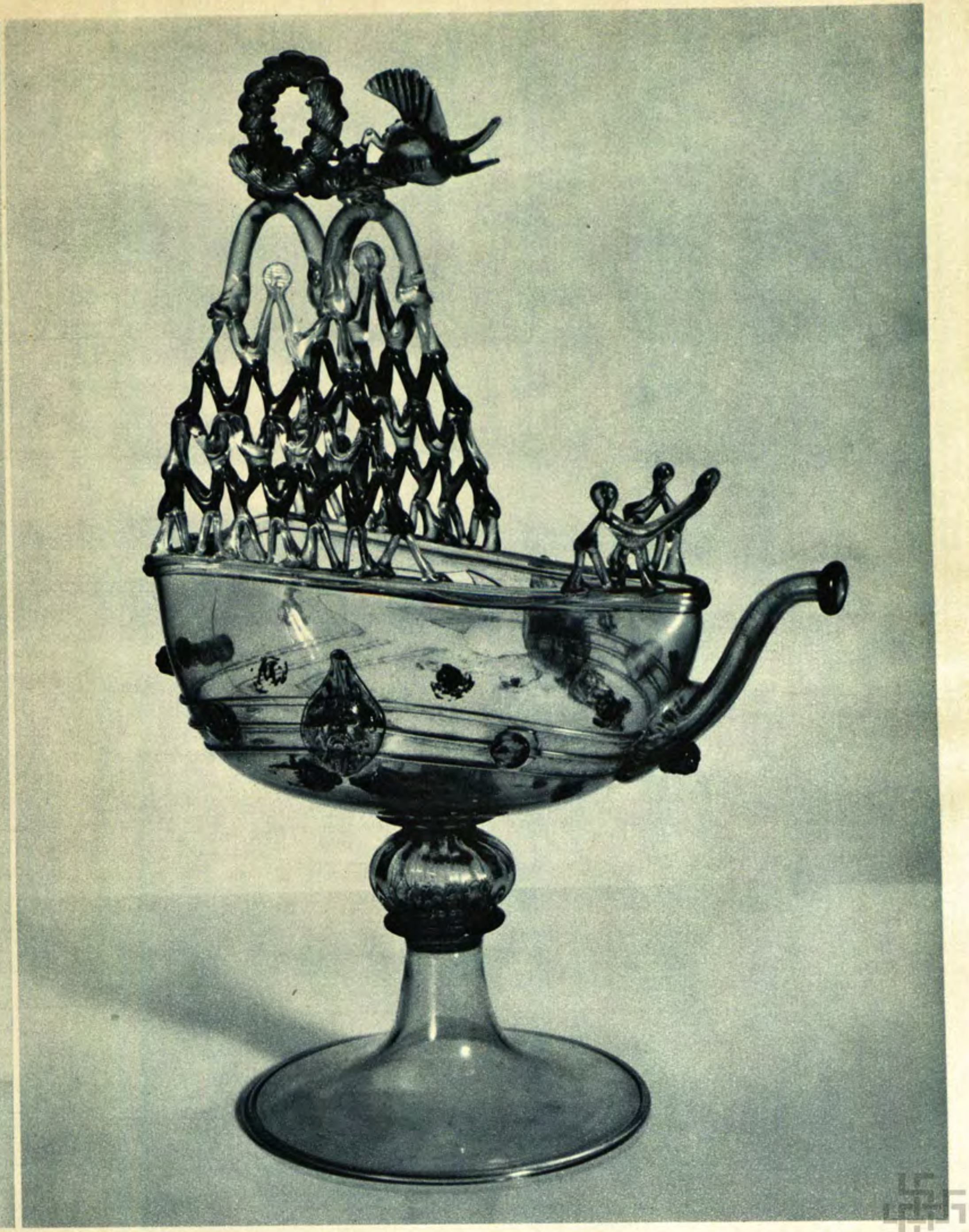




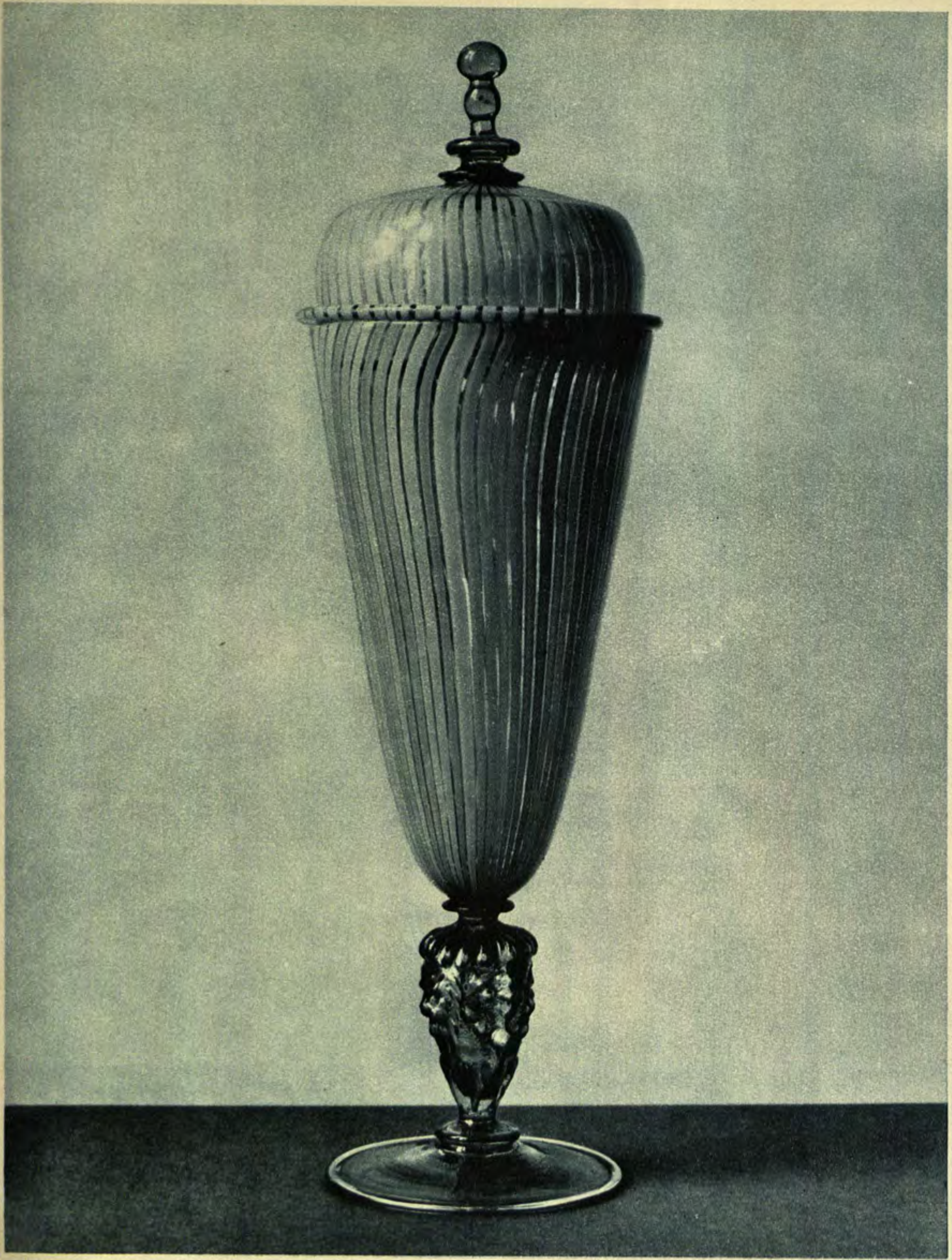
114. Venetian Drinking Vessels with Fired-on Decorations. 16th—18th Cent. (PACM) 115. Venetian "Wing" Glasses with Stippled Decorations. 16th Cent. (PACM)



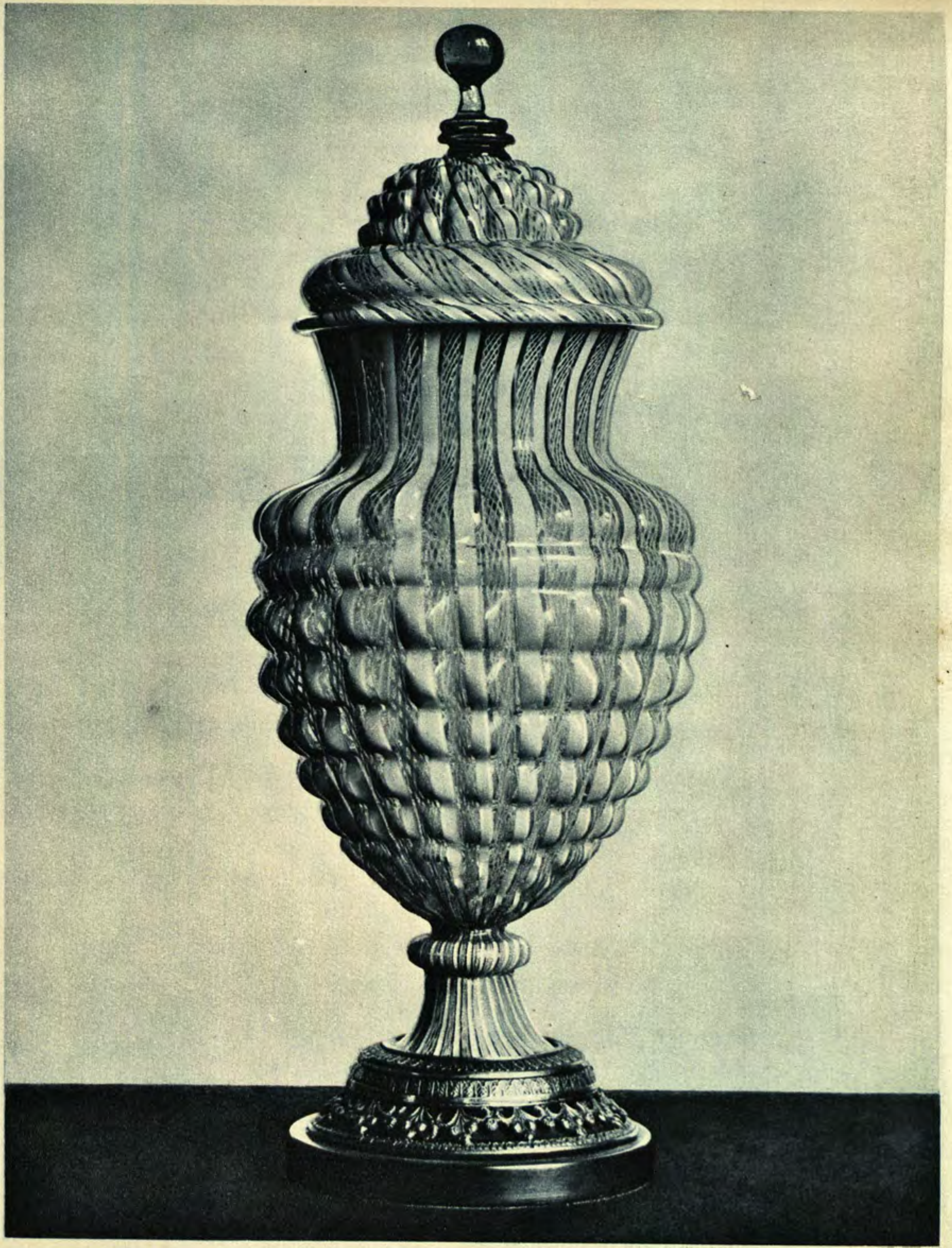
116. Venetian "Wing" Glasses with Stippled Decorations. 16th Cent.



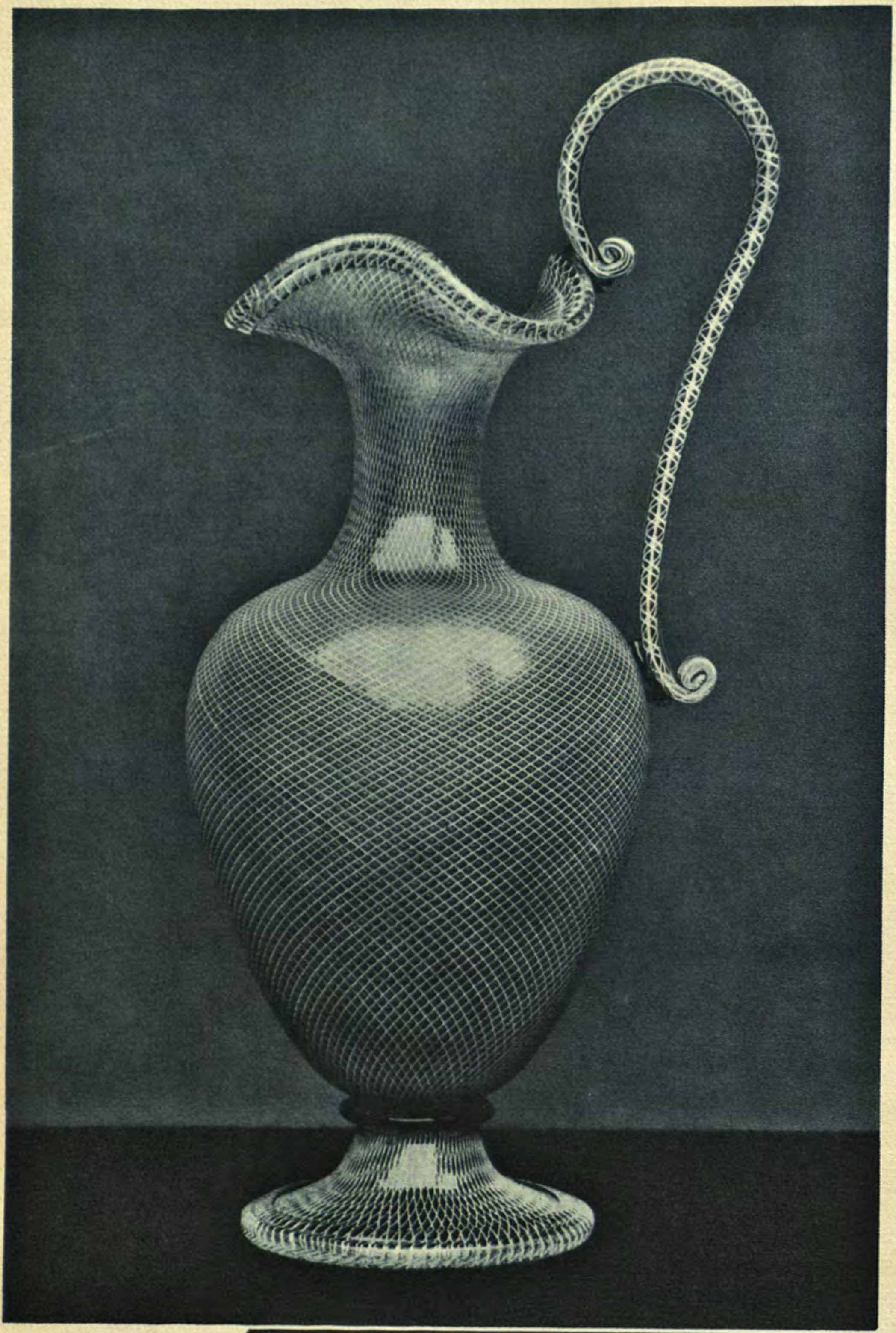
117. Vessel Blown in the Shape of a Ship. Venice. 16th Century. (PACM) Photo: J. Brok, Prague.



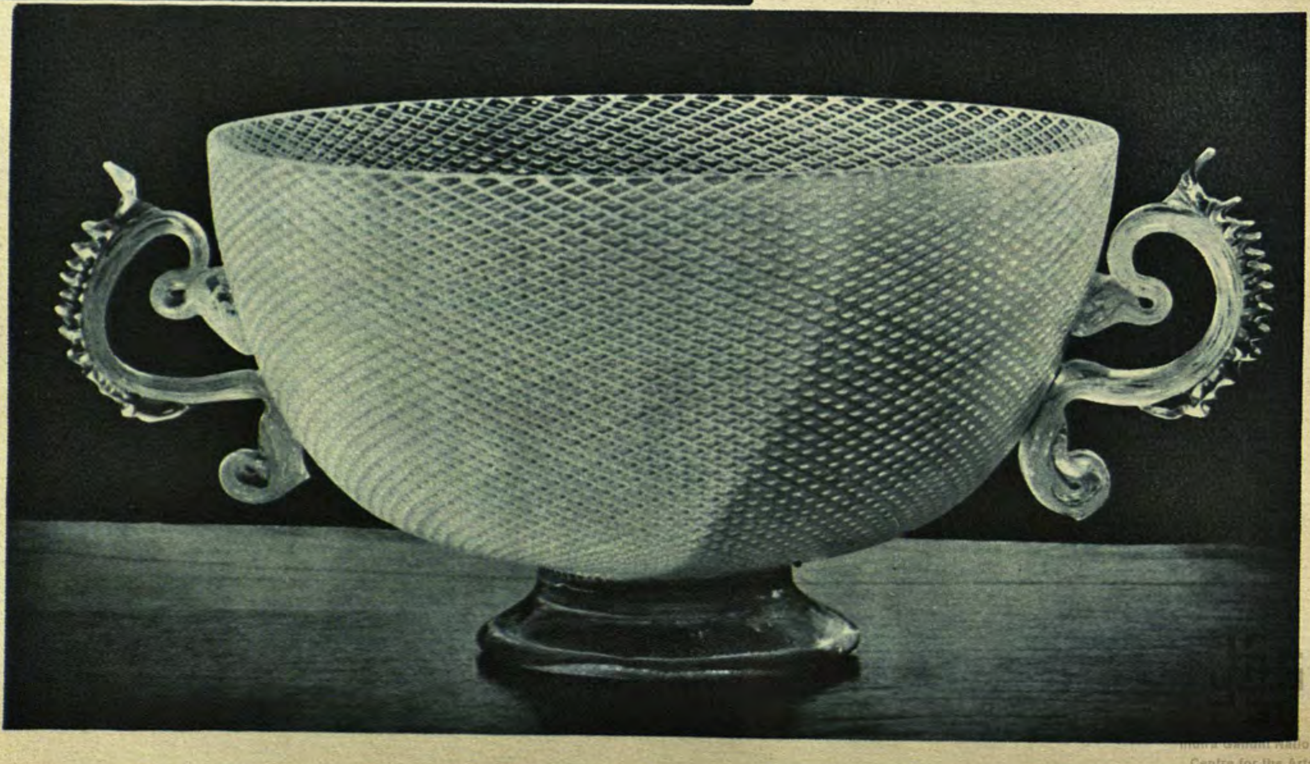
118. Venetian Glass with Lid. Thread-Glass. 16th Cent. (PACM)



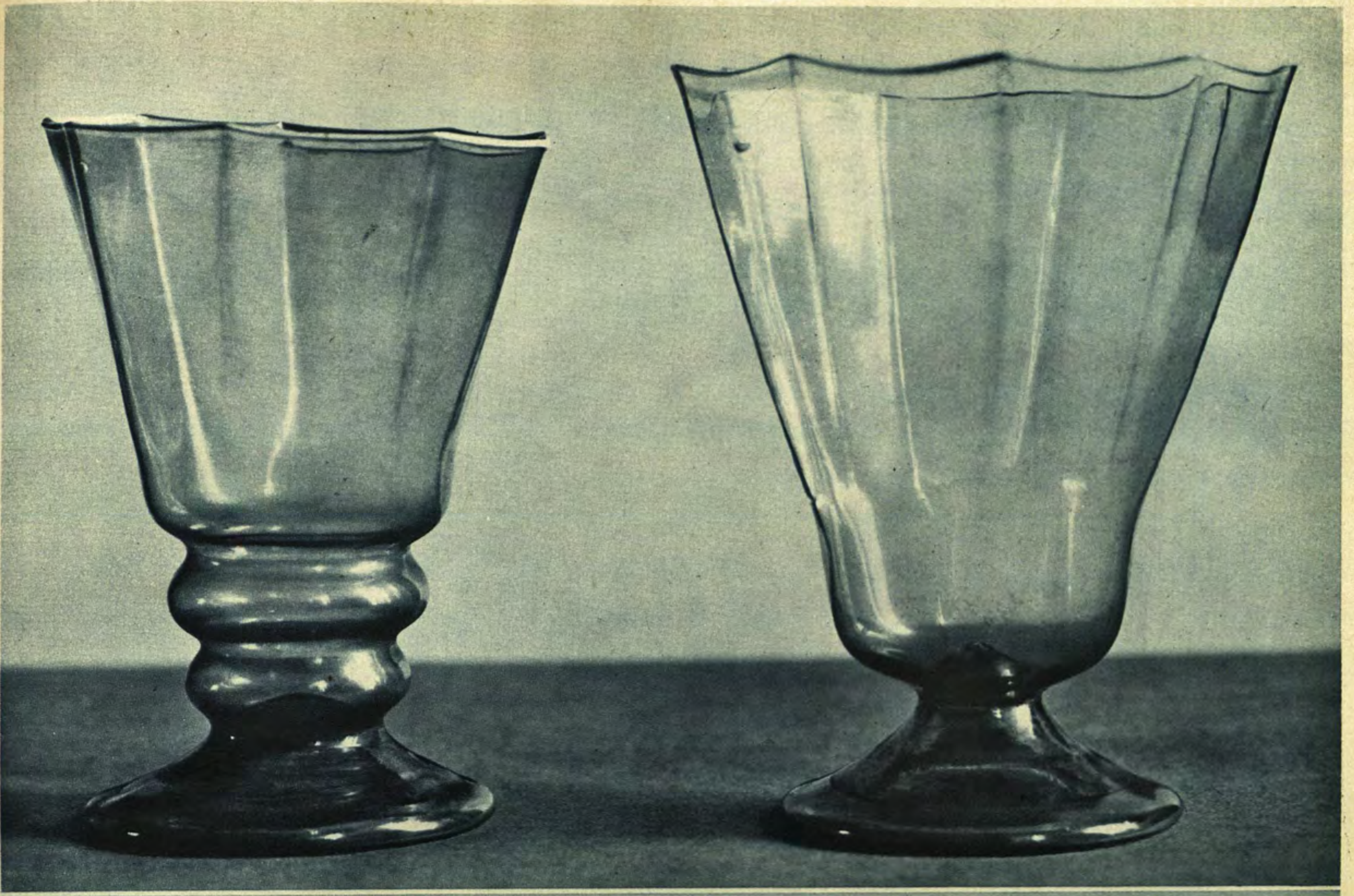
119. Venetian Glass with Lid. Thread-Glass. 16th Cent. (PACM)

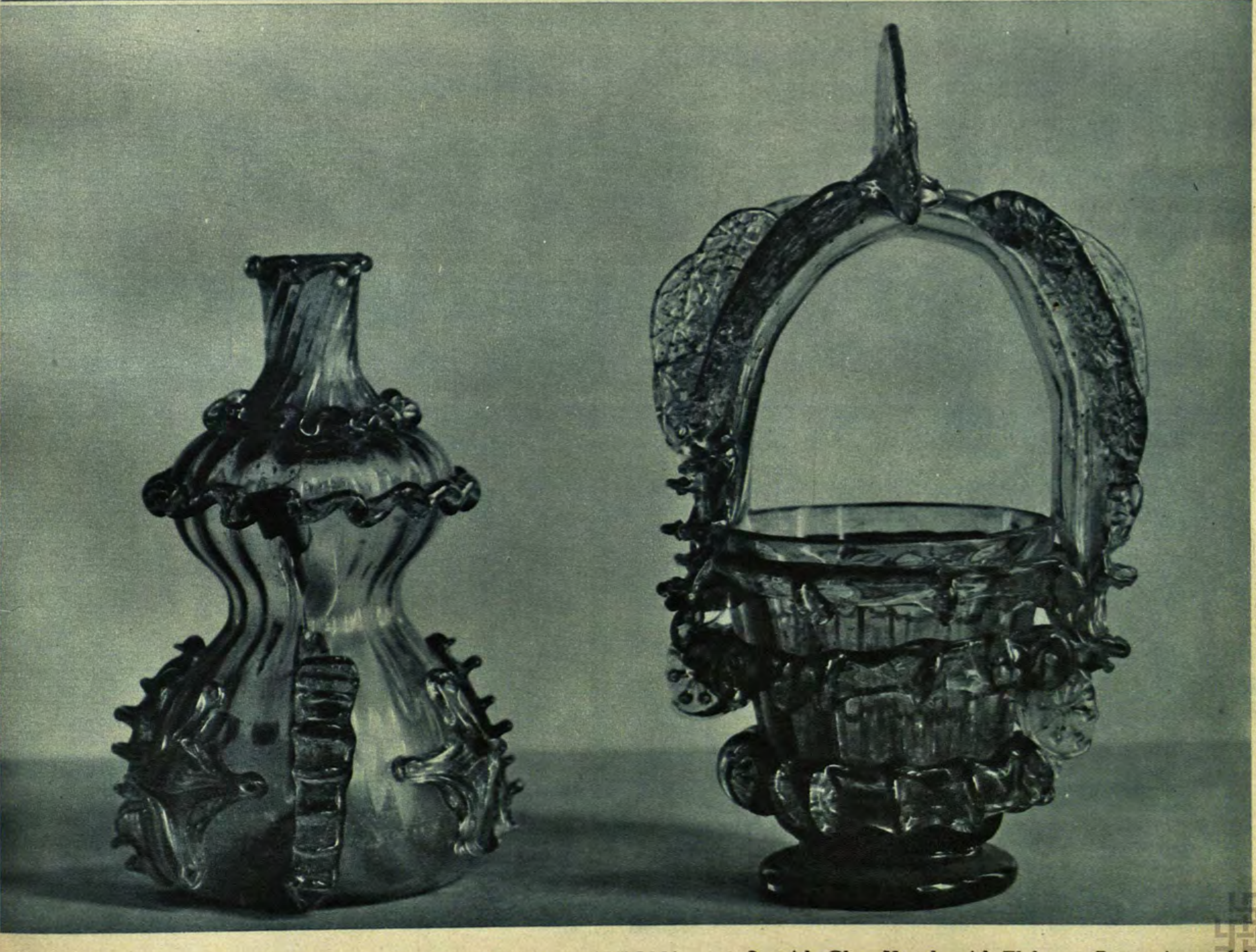


120. Small Venetian Jug Made of Netted Thread-Glass. First Half of the 17th Cent.

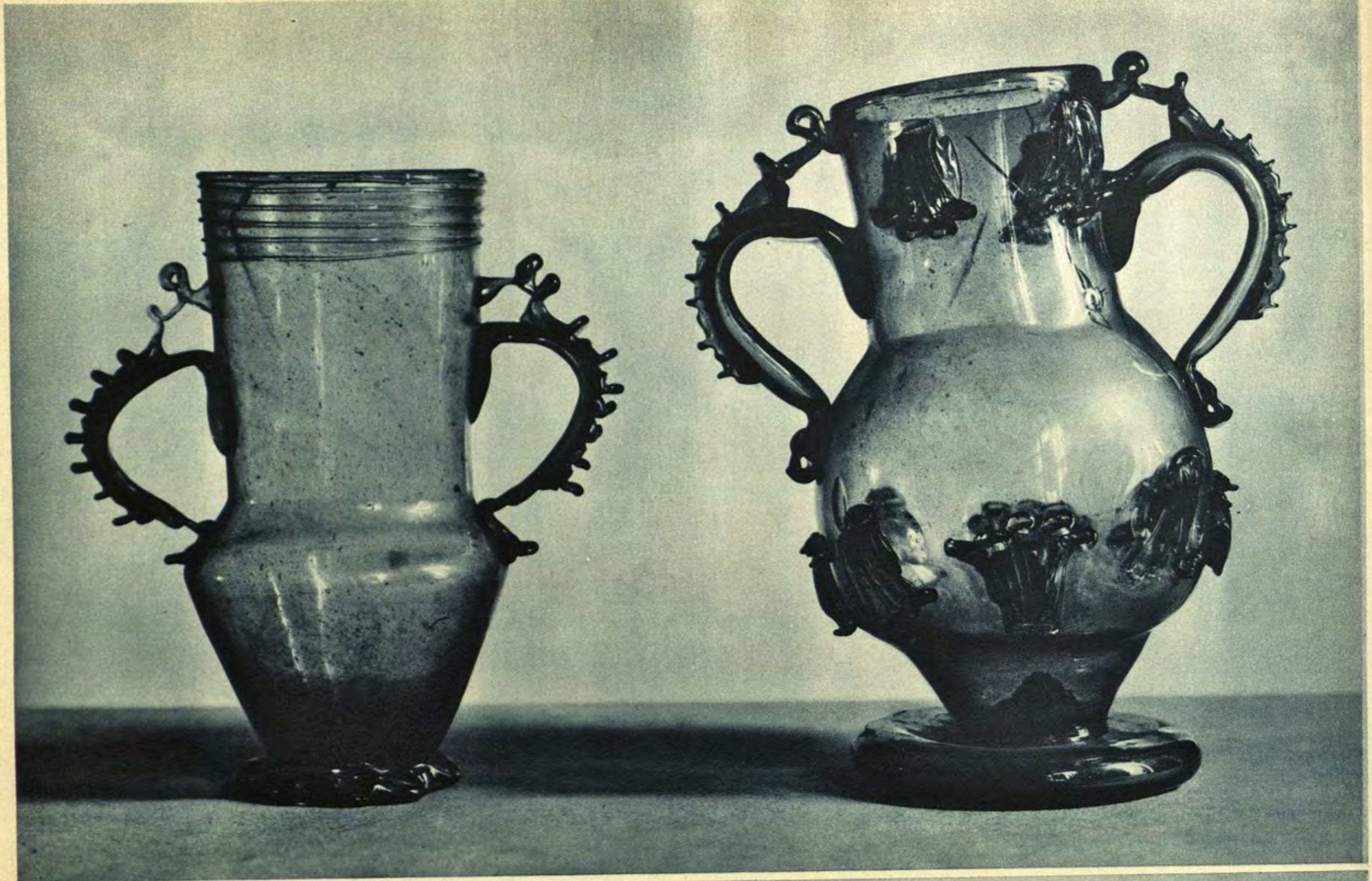


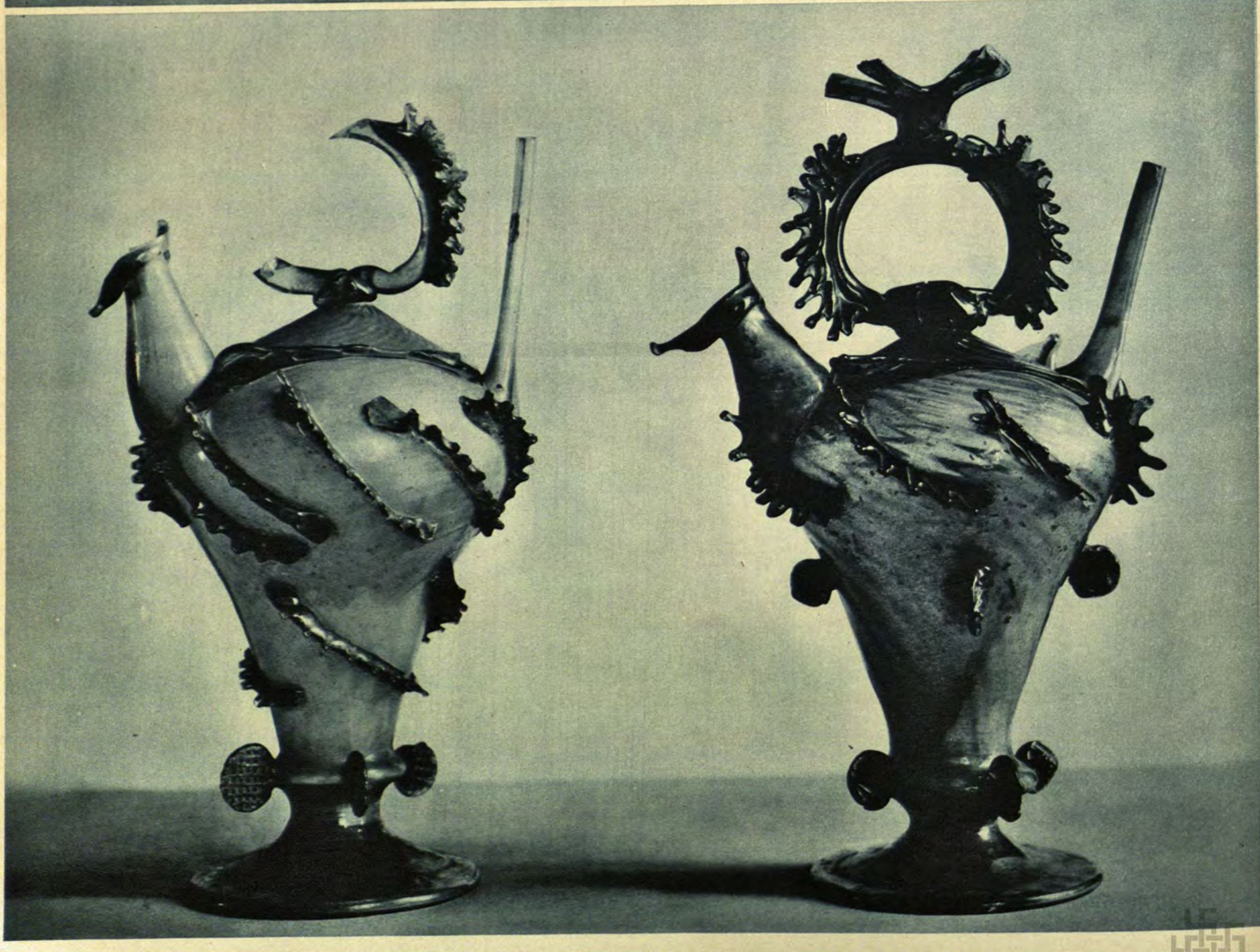
121. Magnificent Venetian Dish of Netted Thread-Glass. (PACM)



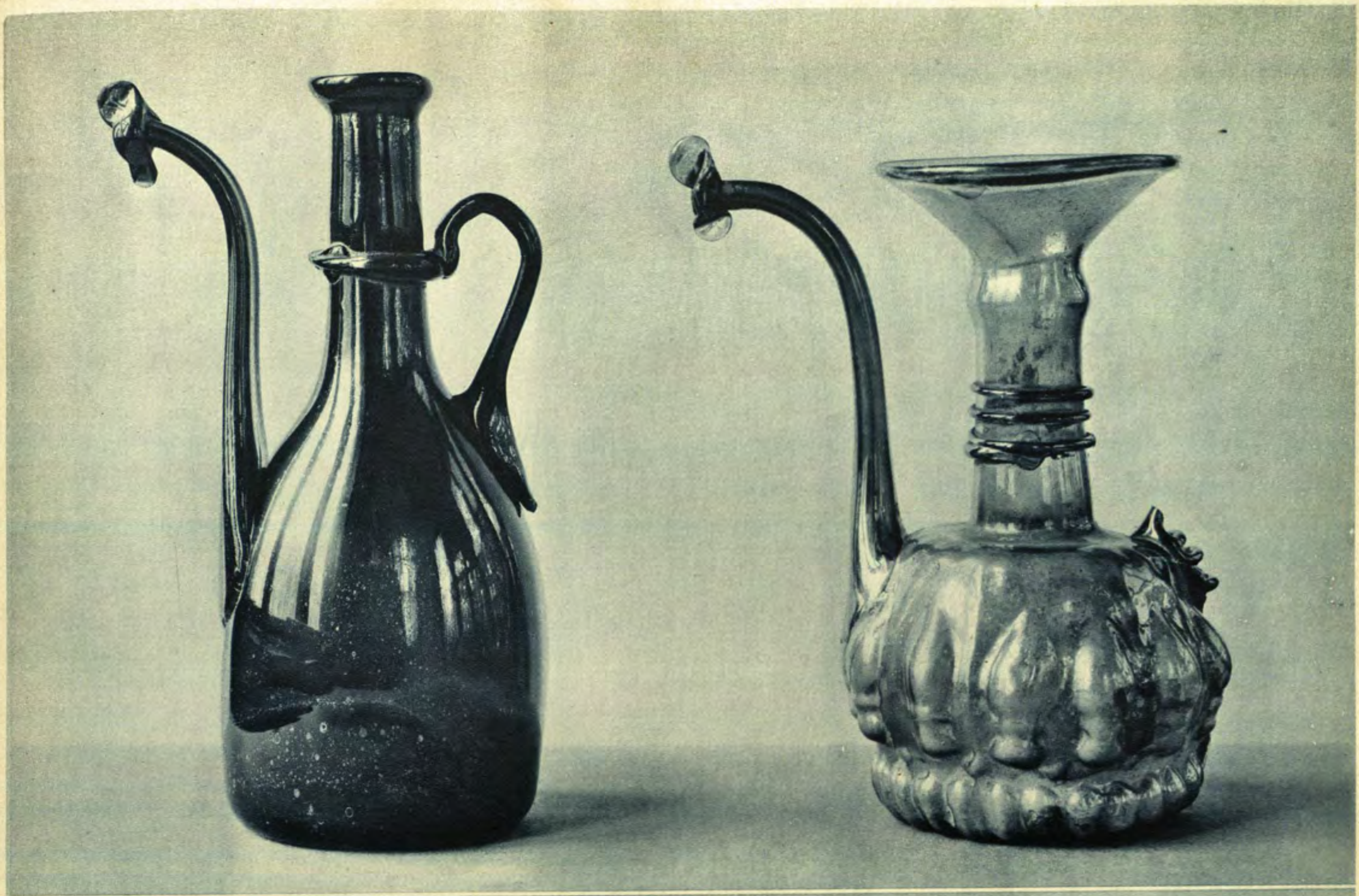


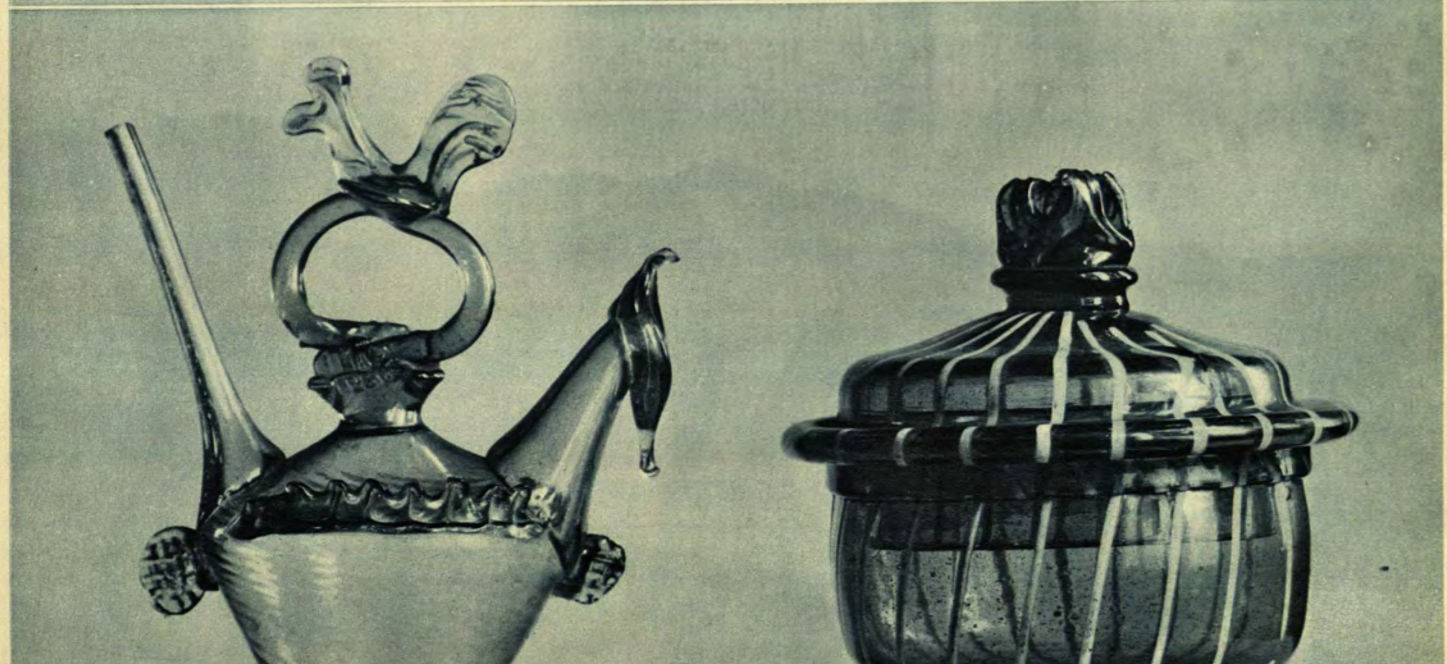
122. Two Spanish Beakers with Milk-Glass Edges. 18th Cent. (PACM) 123. Spanish Glass Vessels with Elaborate Decorations. 16th to 18th Cent. (PACM)



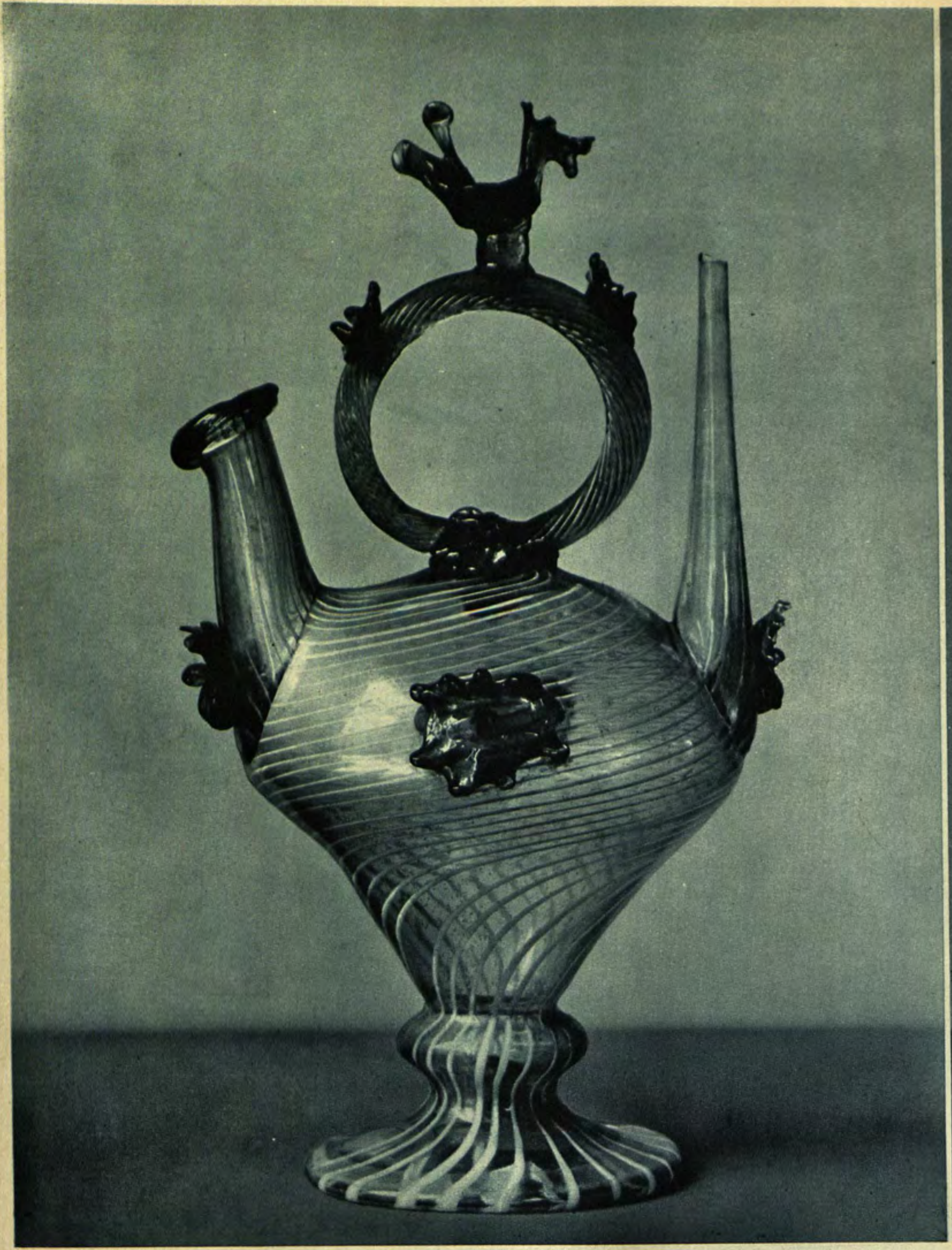


124. Two Spanish Vases, one Made of Green Glass with Handles and Attached Decorations in the Shape of Shells, 18th Cent.; the Other from Catalonia, Yellow with Melted-on Decorations. (PACM) 125. Green and Blue Spanish Vessels with Elaborate Fired-on Decorations. (PACM)

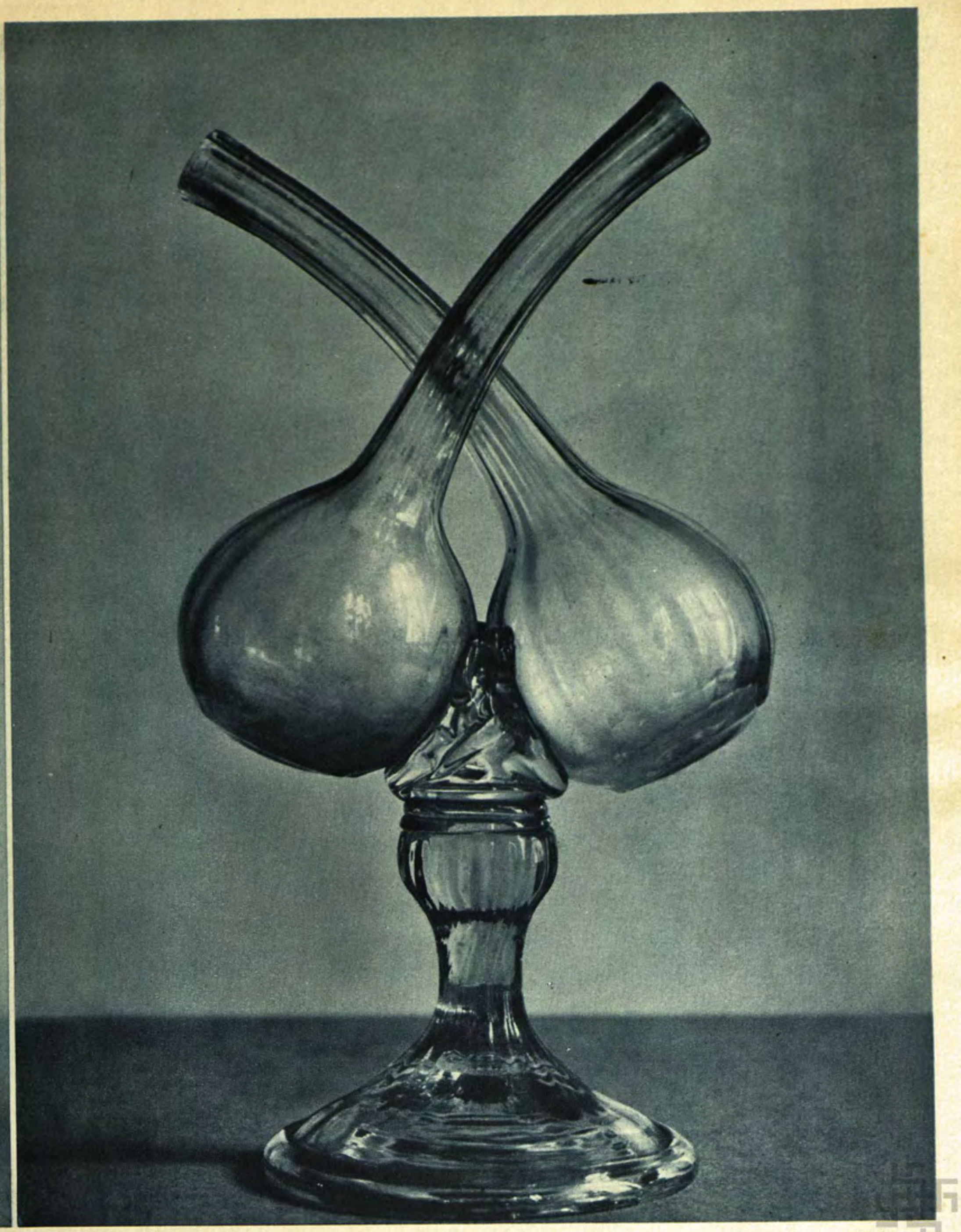




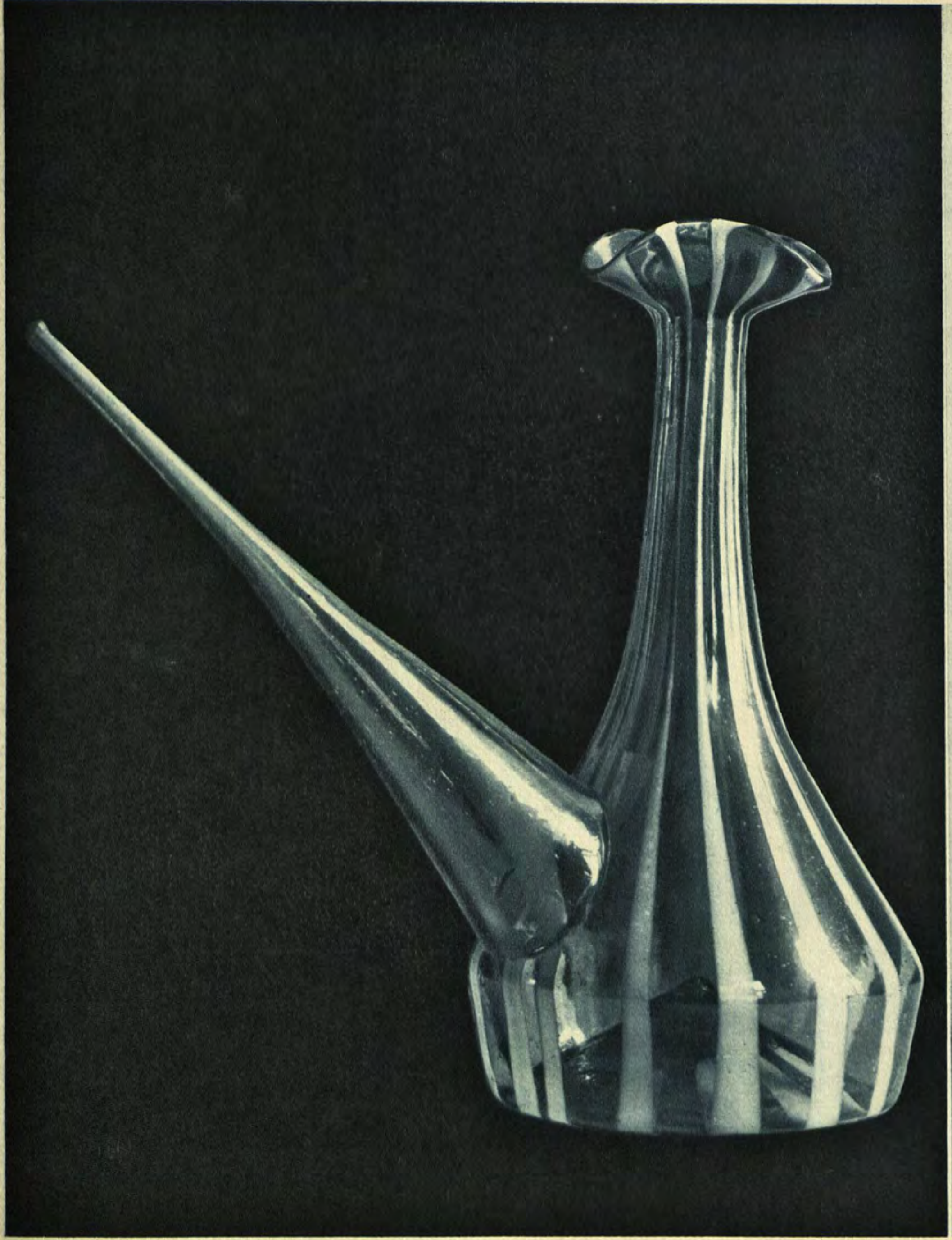
126. Persian (Iranian) Jug with Fired-on Decorations of Coloured Glass. (PACM) 127. Catalan Vessel of White Glass with Fired-on Decorations. Catalan Dish with a Lid, Greenish Colour with White Threads, Worked in the Venetian Fashion. From the 17th Cent. A Small Vessel of White Glass with Fired-on, Partly Winged Decorations from the Same Period. (PACM)



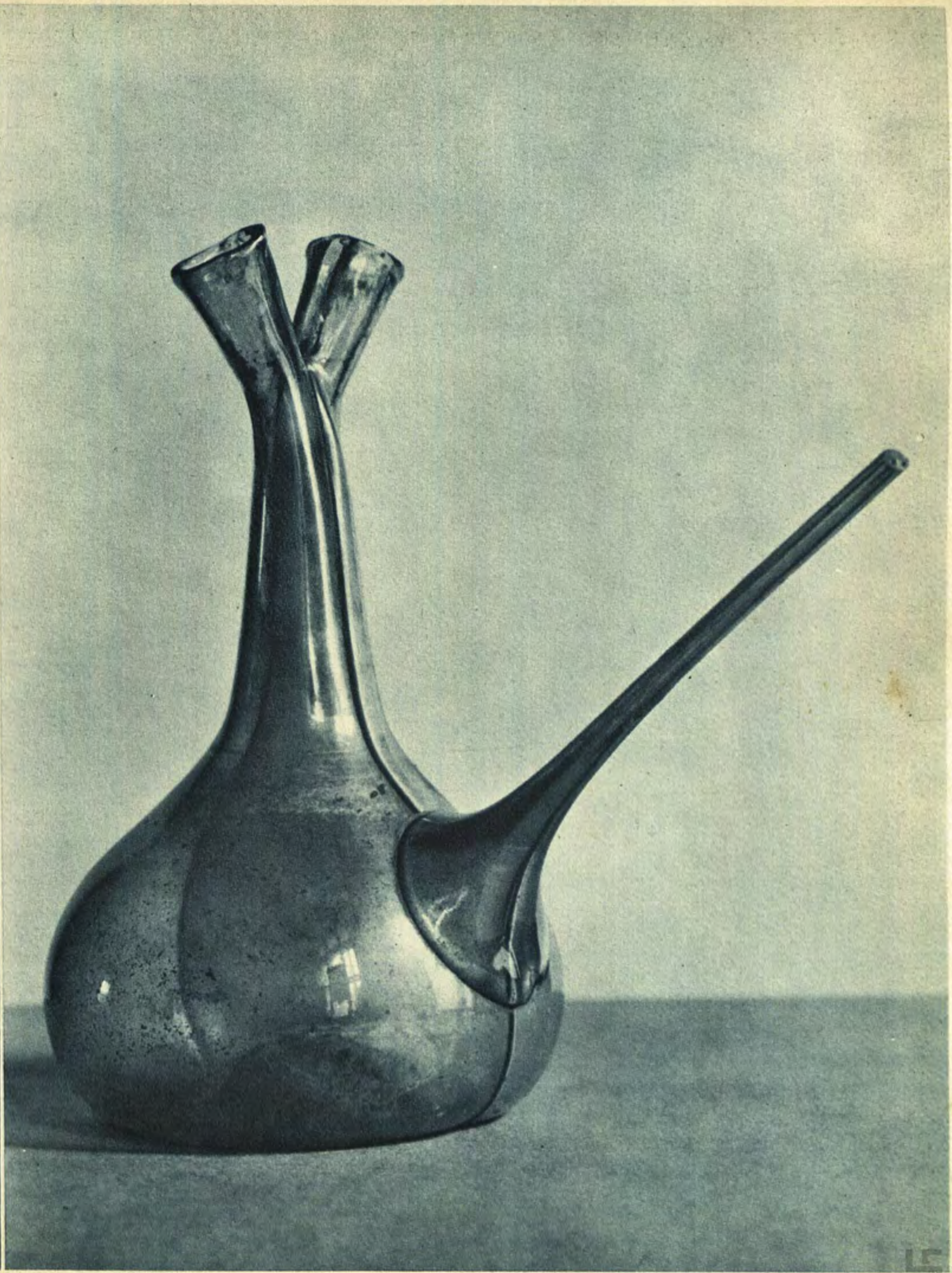
128. Small Jug of Thread-Glass, Spain, 1700. (PACM)



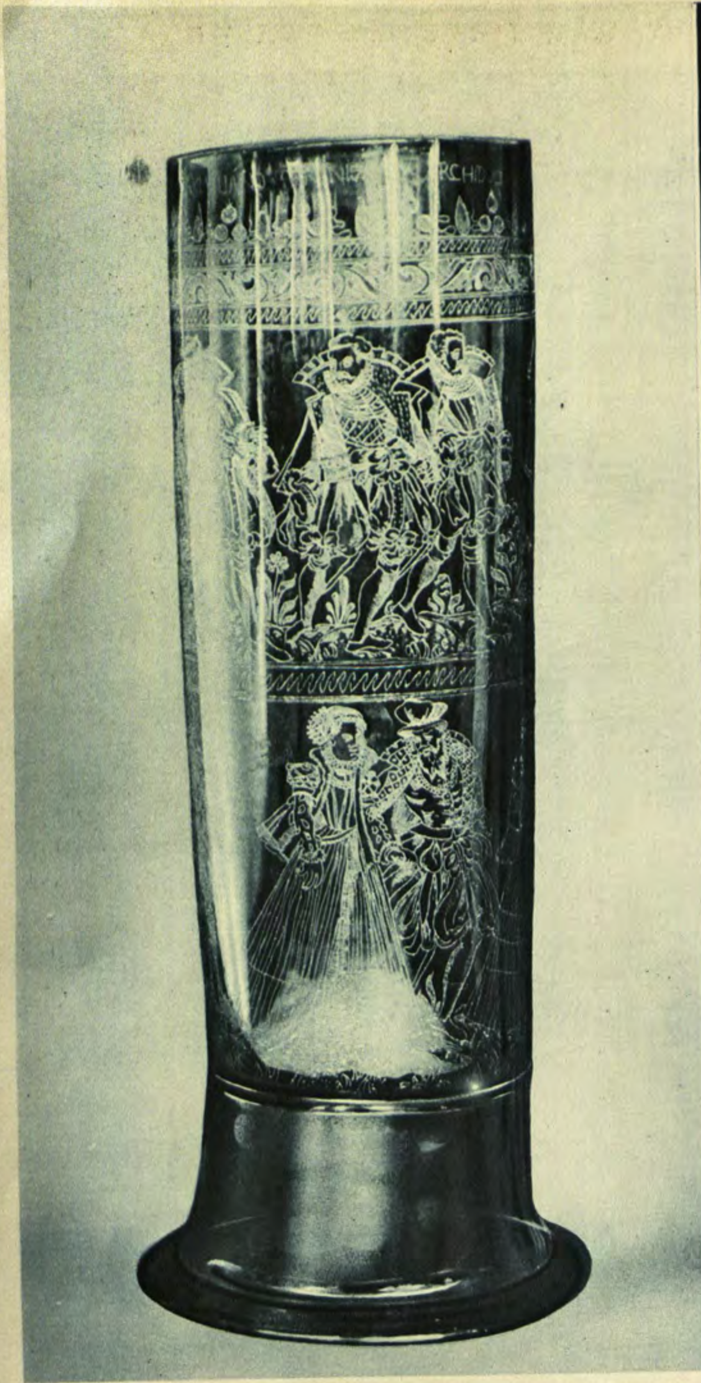
129. Spanish Vessel for Oil and Vinegar. 18th Cent. (PACM)

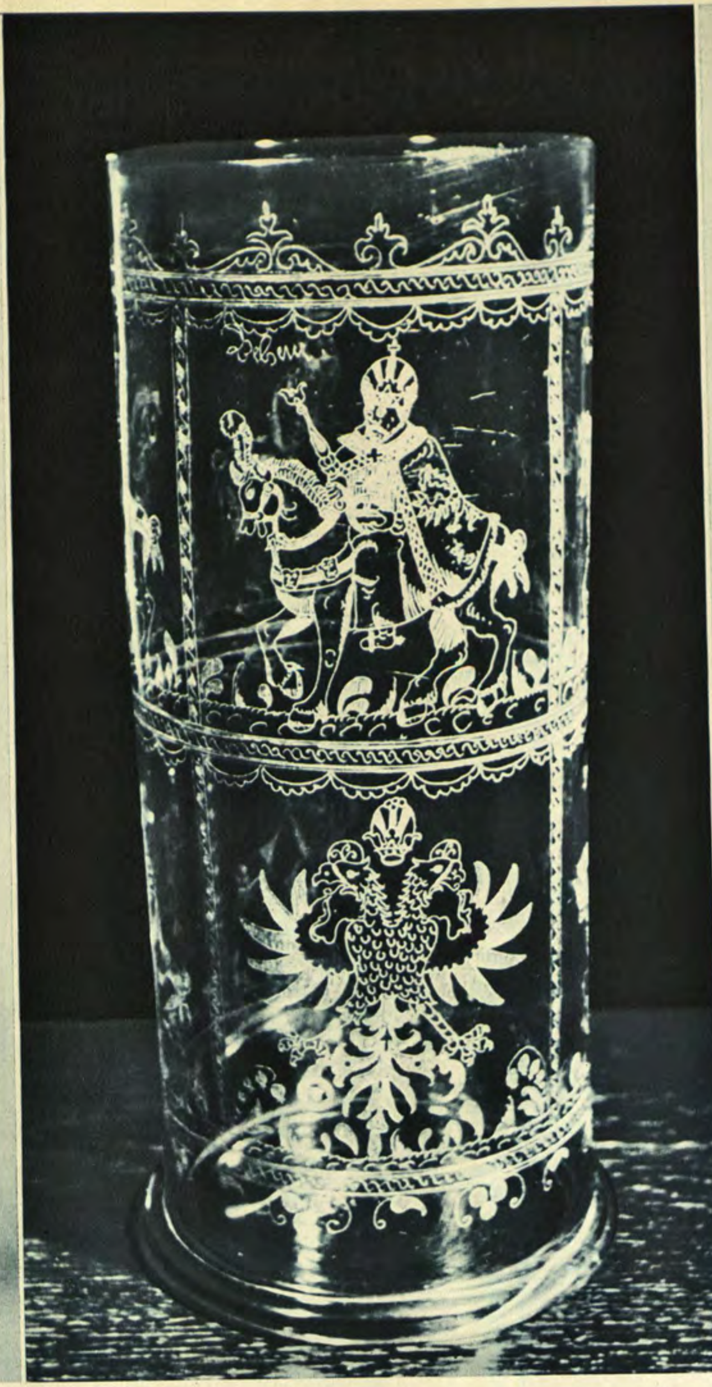


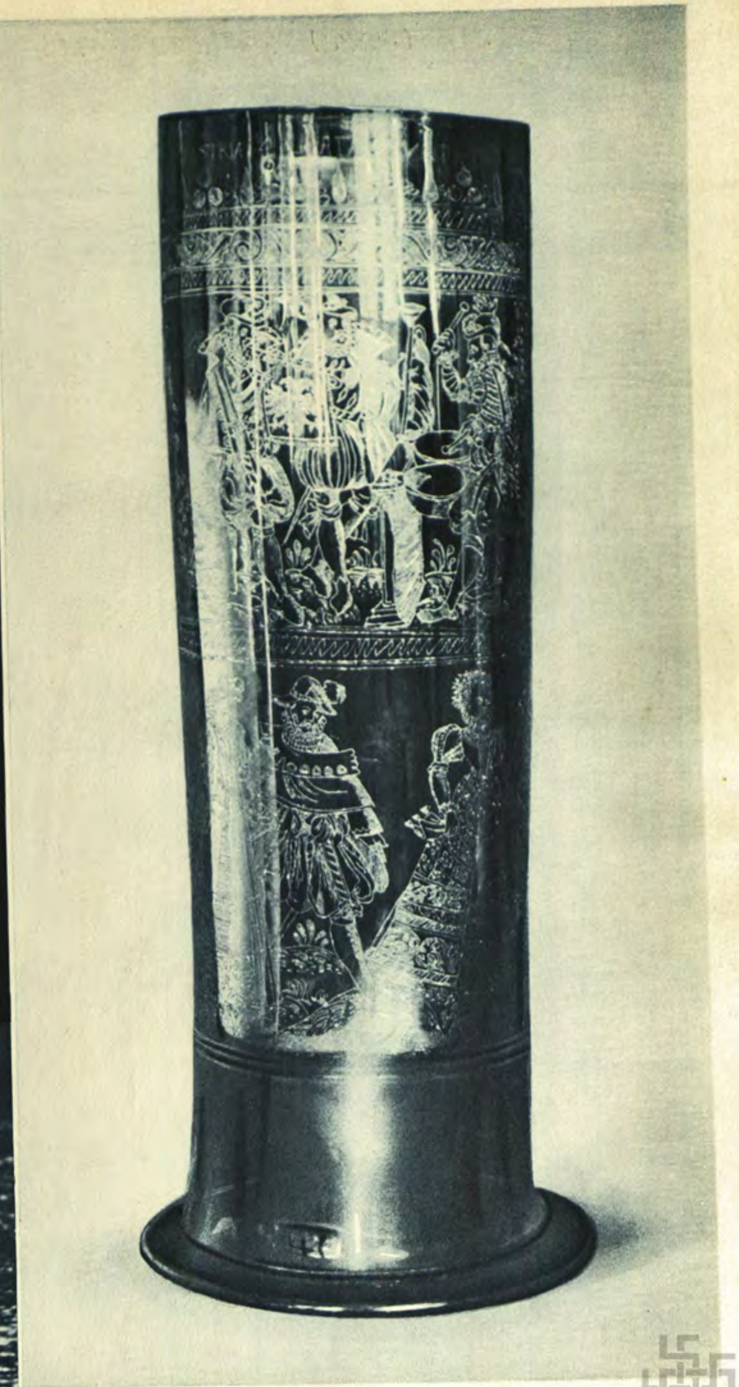
130. *Yellow-Striped Catalan Flask with a Spout.* (PACM)



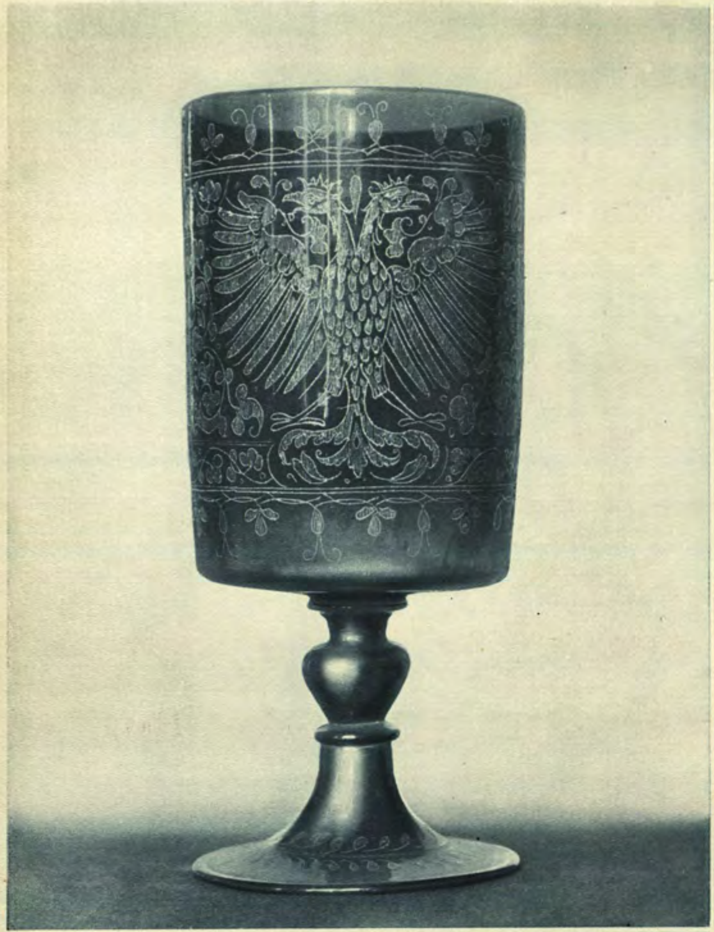
131. *Oil and Vinegar Bottle, Spain.* (PACM)

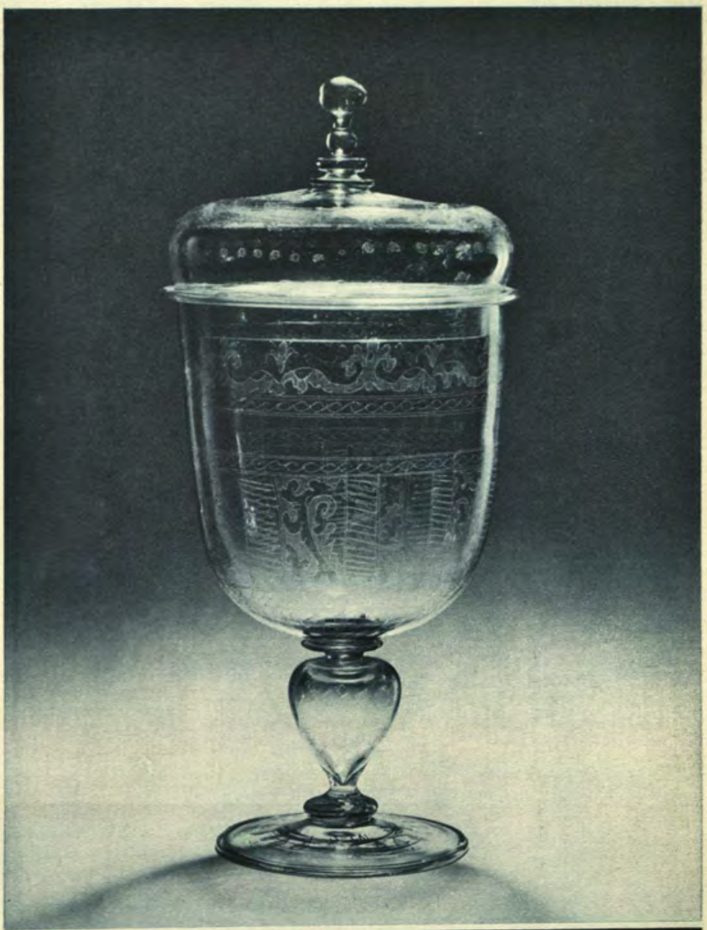


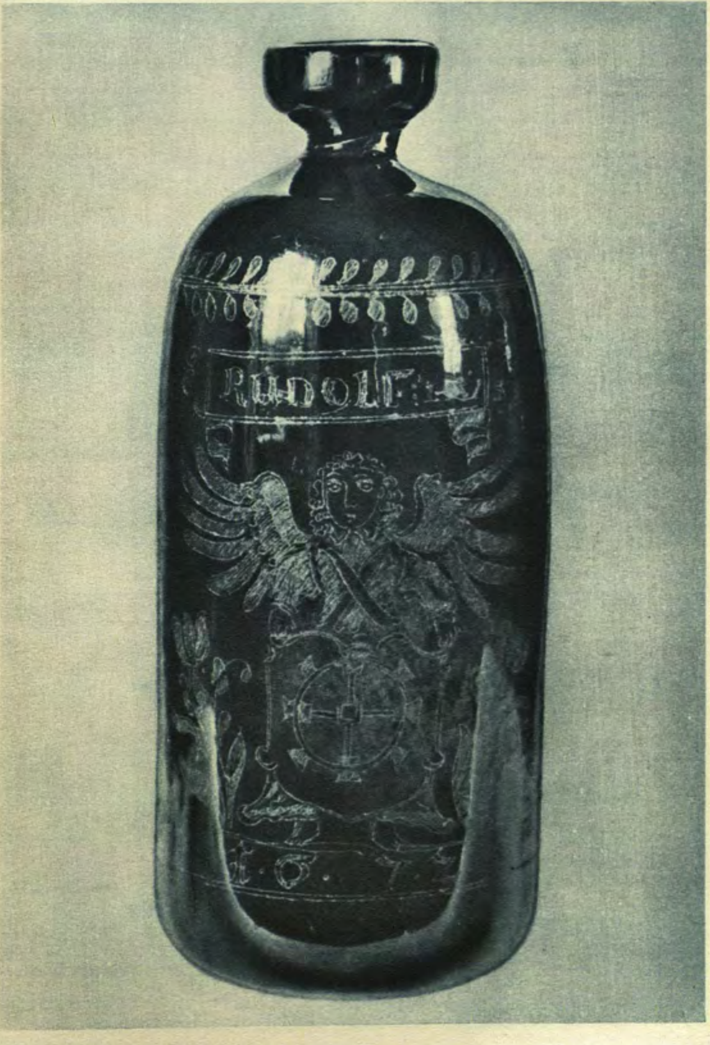


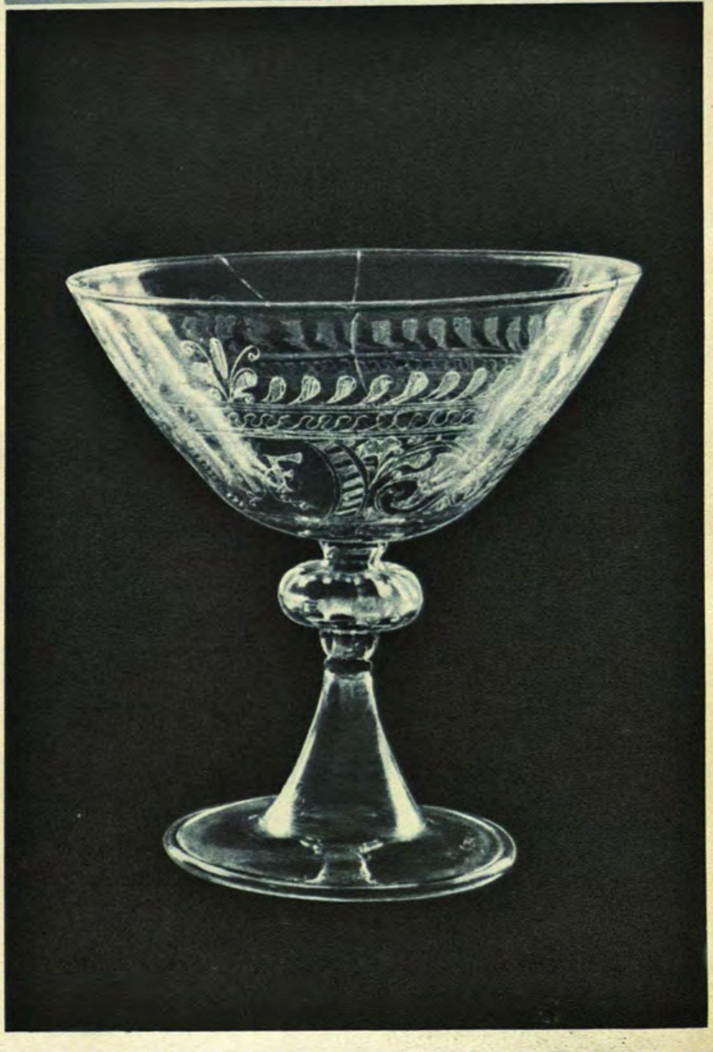


132. and 134. The Maximilian Beaker, Diamond Engraving on Both Sides. Moravia, 1582. Castle Buchlov. (PACM) 133. Diamond Engraving on a South Bohemian Drinking Vessel Depicting the Emperor and the Grand Electors. Apparently 1600. (PACM)

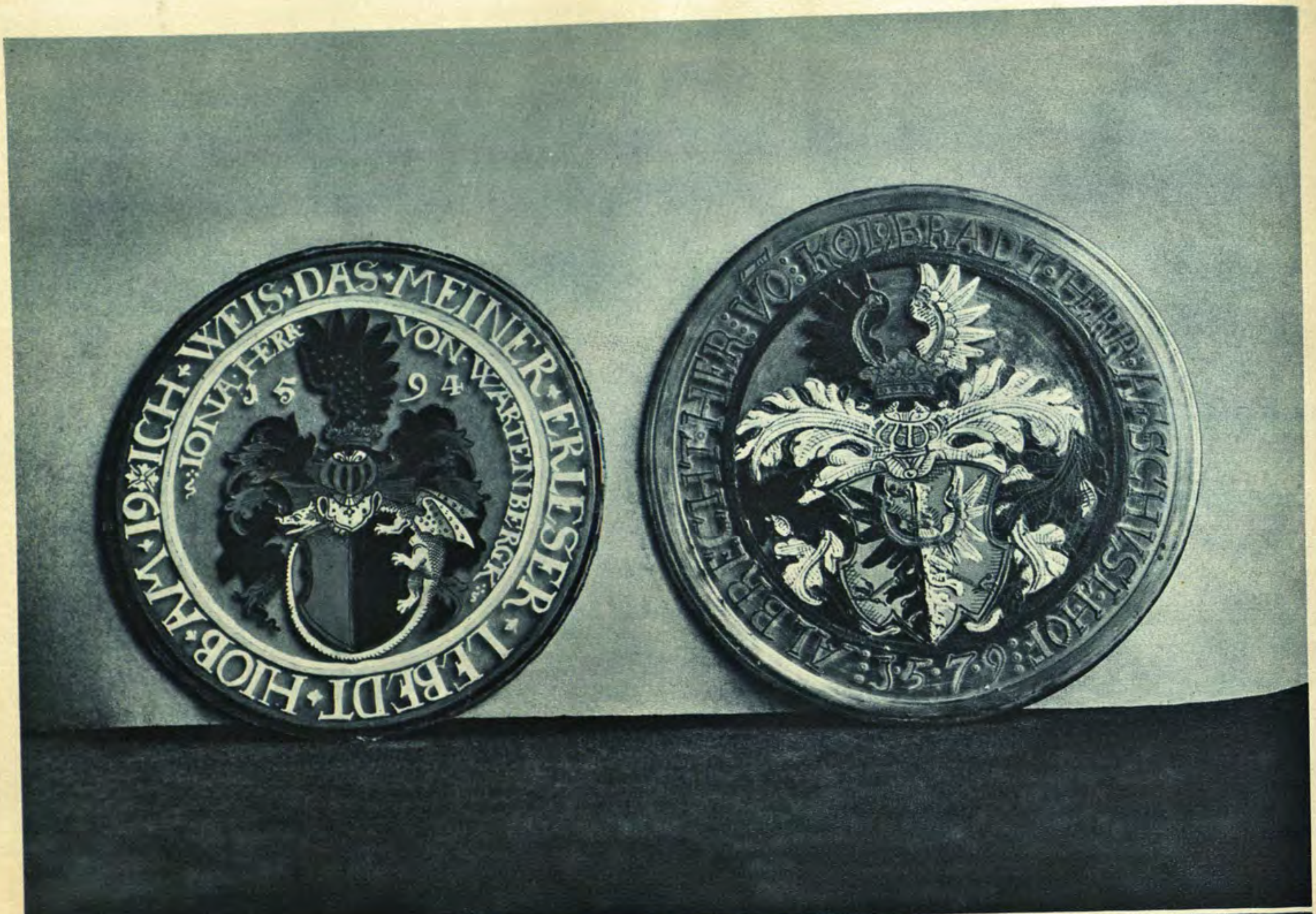


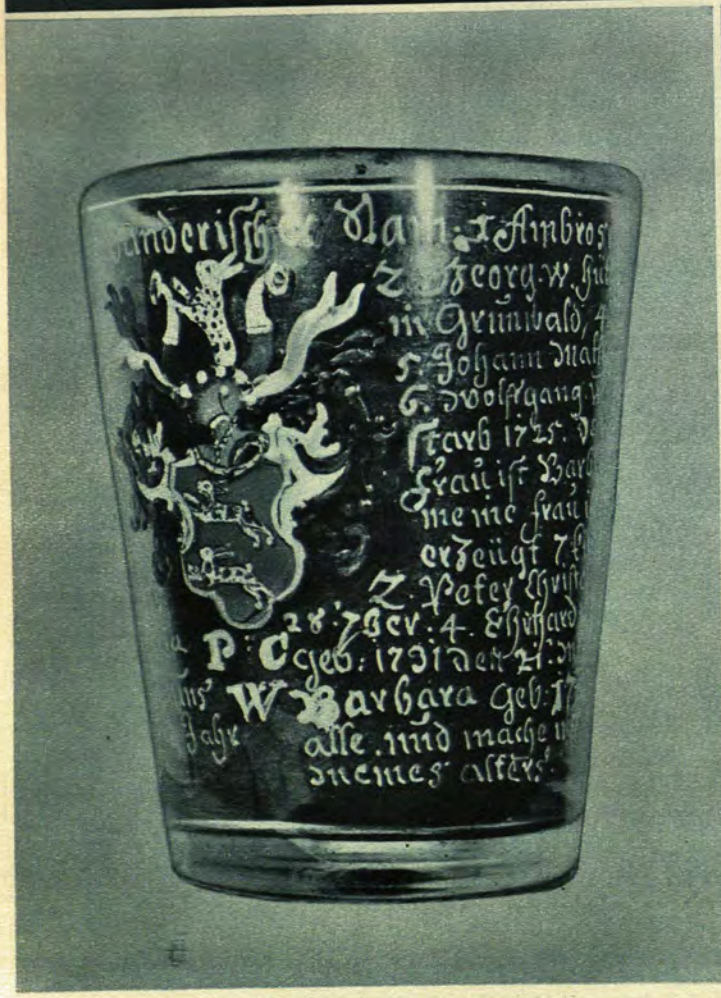


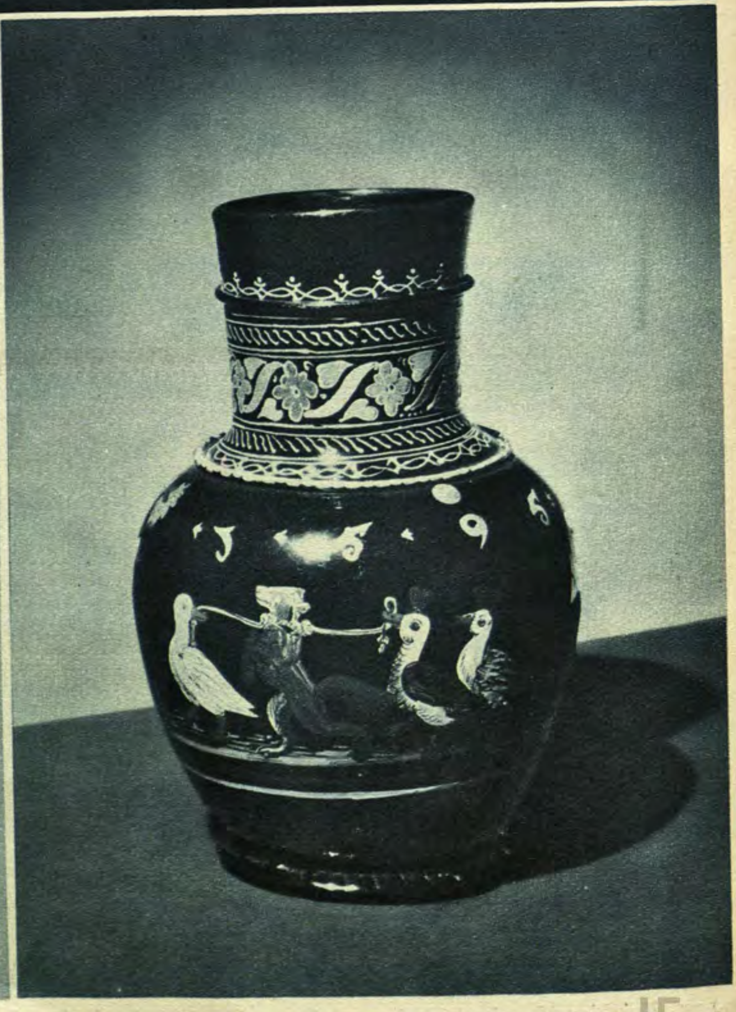




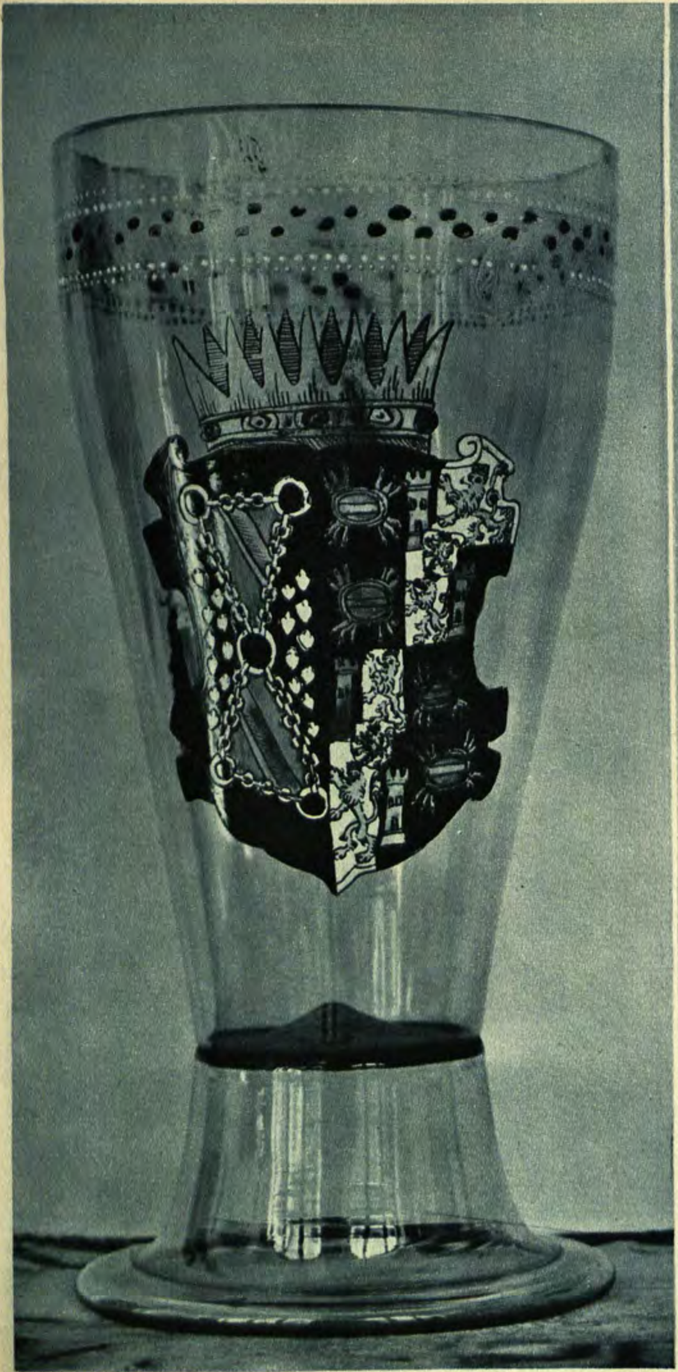
135. Drinking Vessel with Diamond Engraving. Hall in the Tyrol. 16th Cent. (PACM) 136. Glass with a Lid. Diamond Engraving. (PACM) 137. Dark Blue, Cylindrical-Shaped Bottle from Southern Germany, with Diamond Engraving. About 1672. Angel with the Symbol of the Millers. 138. Giacopo Versalini: English Glass with Diamond Engravings, Dated 1580.

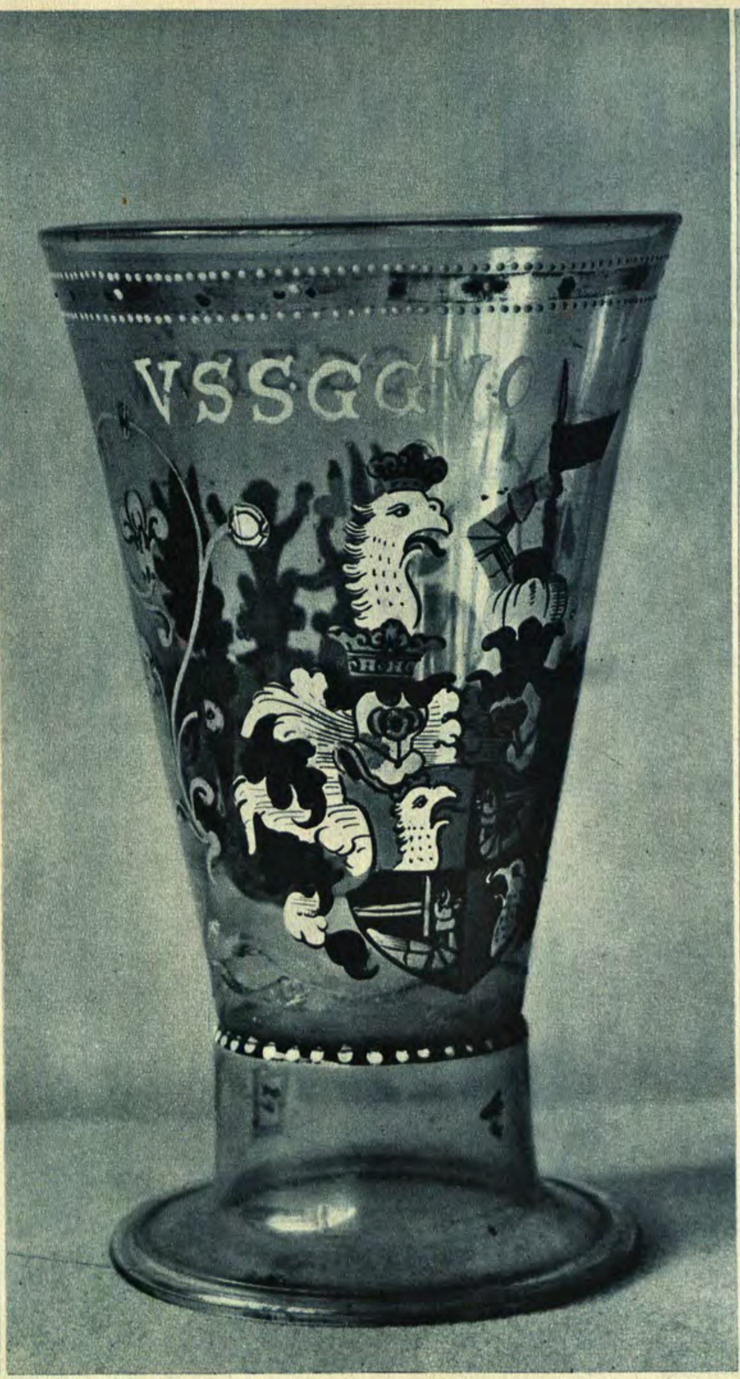

ICH WEIS DAS MEINER ERLESER LEBEDT HIOB AM 19
JONA HERR VON WARTENBERGK
1594
KOLBRADT
1579

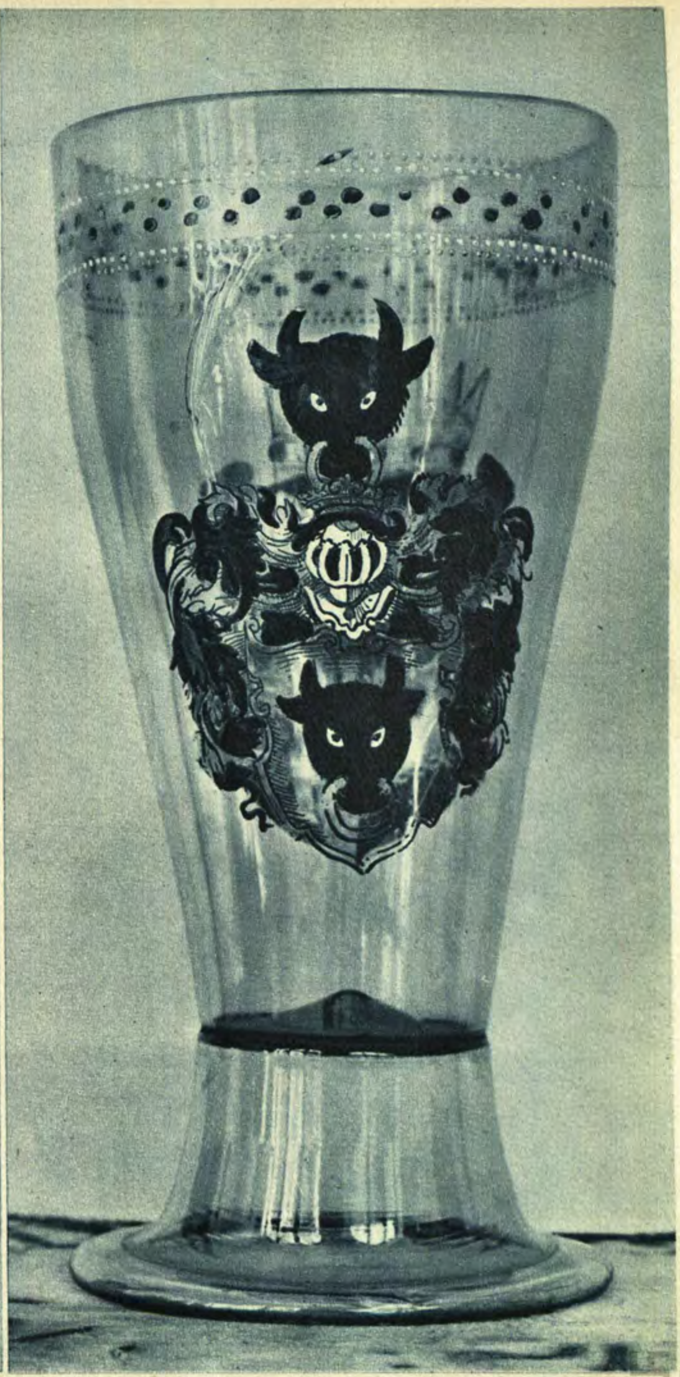




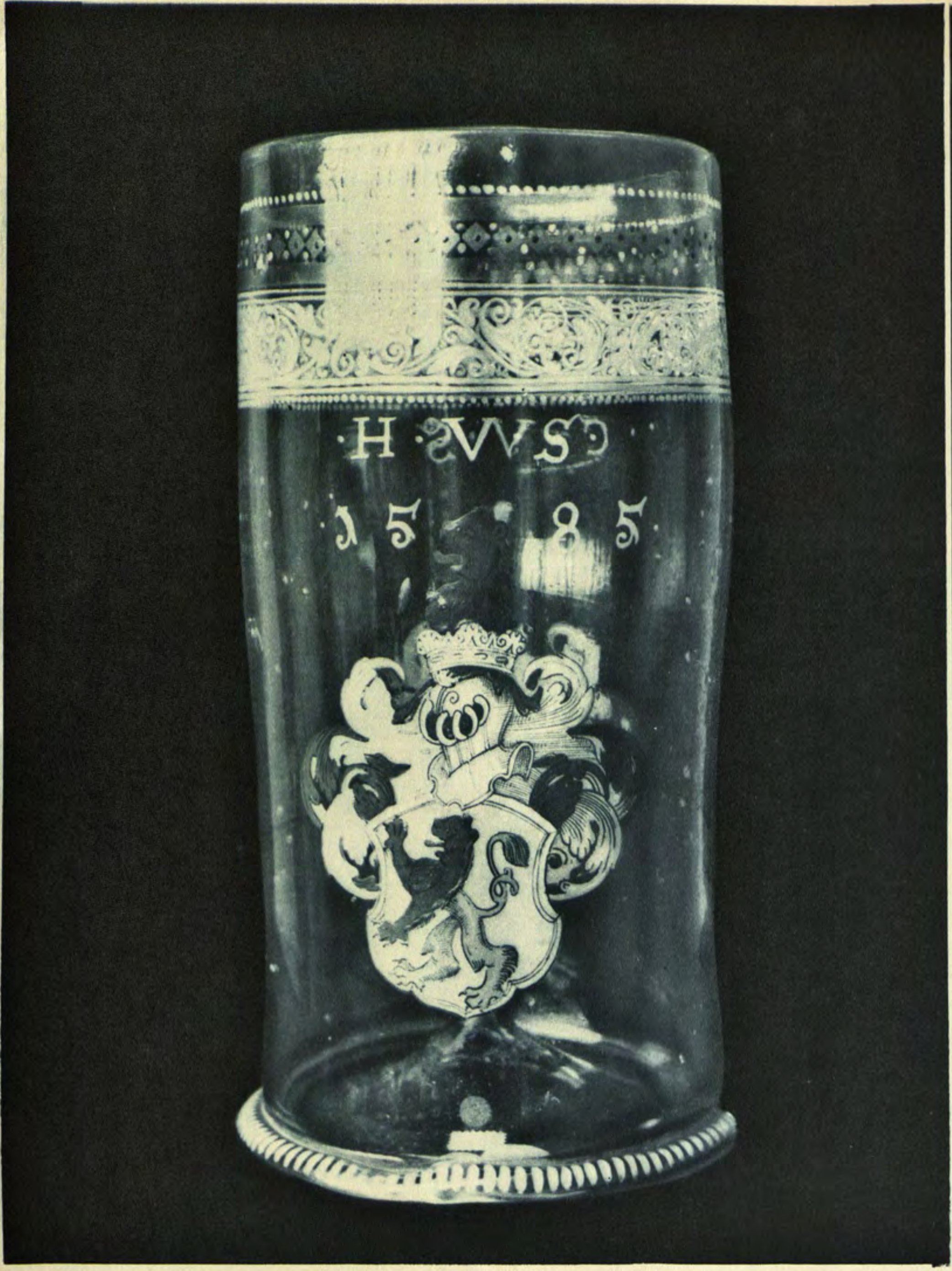
139. *Two Coloured, Enamelled Glass Disks, One with the Coat-of-Arms of the Wartenbergs (Bohemia 1594), the Second with the Coat-of-Arms of the Kolovrat Family (Bohemia 1579). (PACM) 140. Enamelled Beaker, Belonging to the Wanderer Family of Altmannsdorf, Württemberg. (Pazaurek Collection in the PACM.) 141. Enamelled, Bohemian Renaissance Jug of Dark Blue Glass with the Motif of the Fable of the Fox and the Geese. 1595. (PACM). Photo: Illek-Paul.*



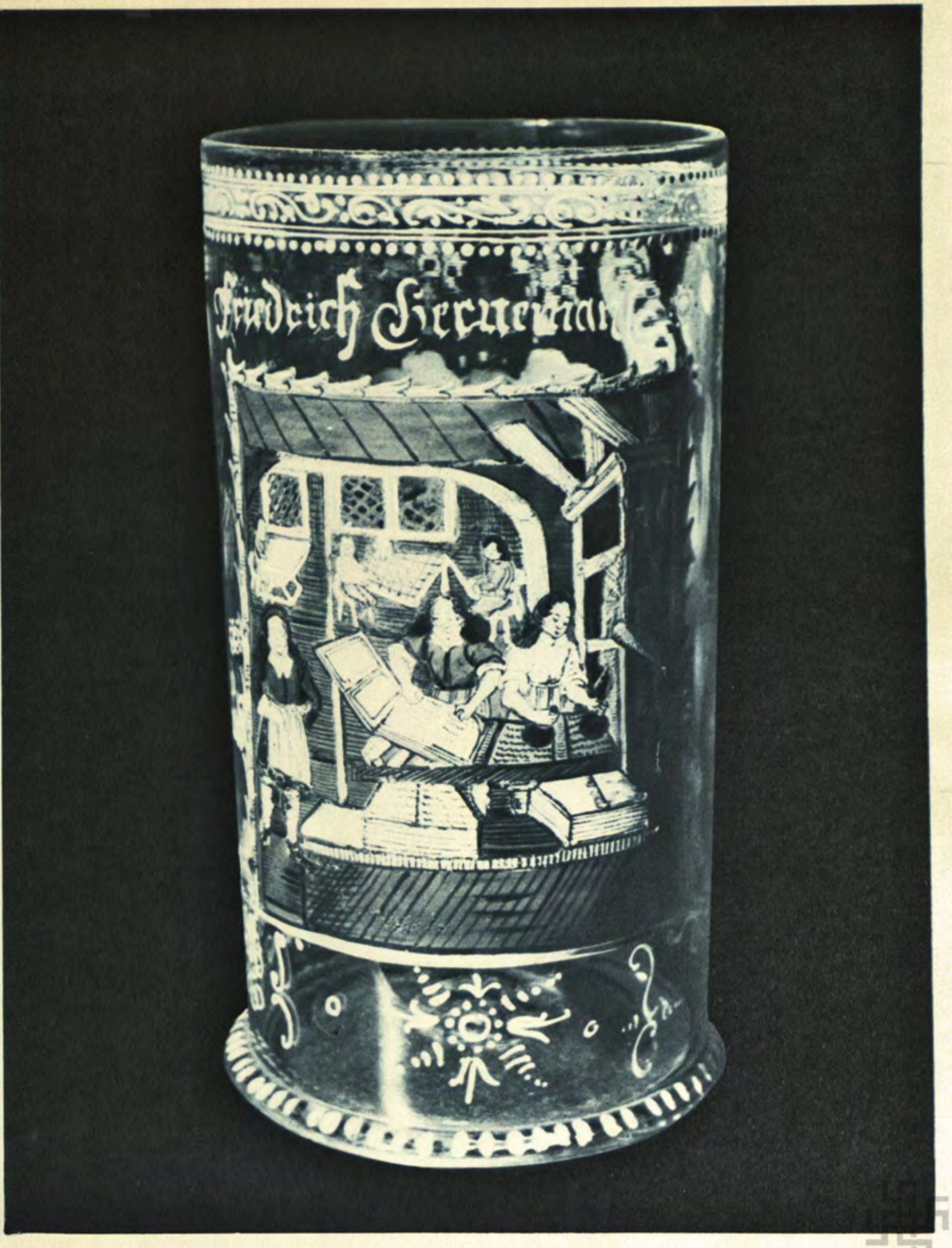




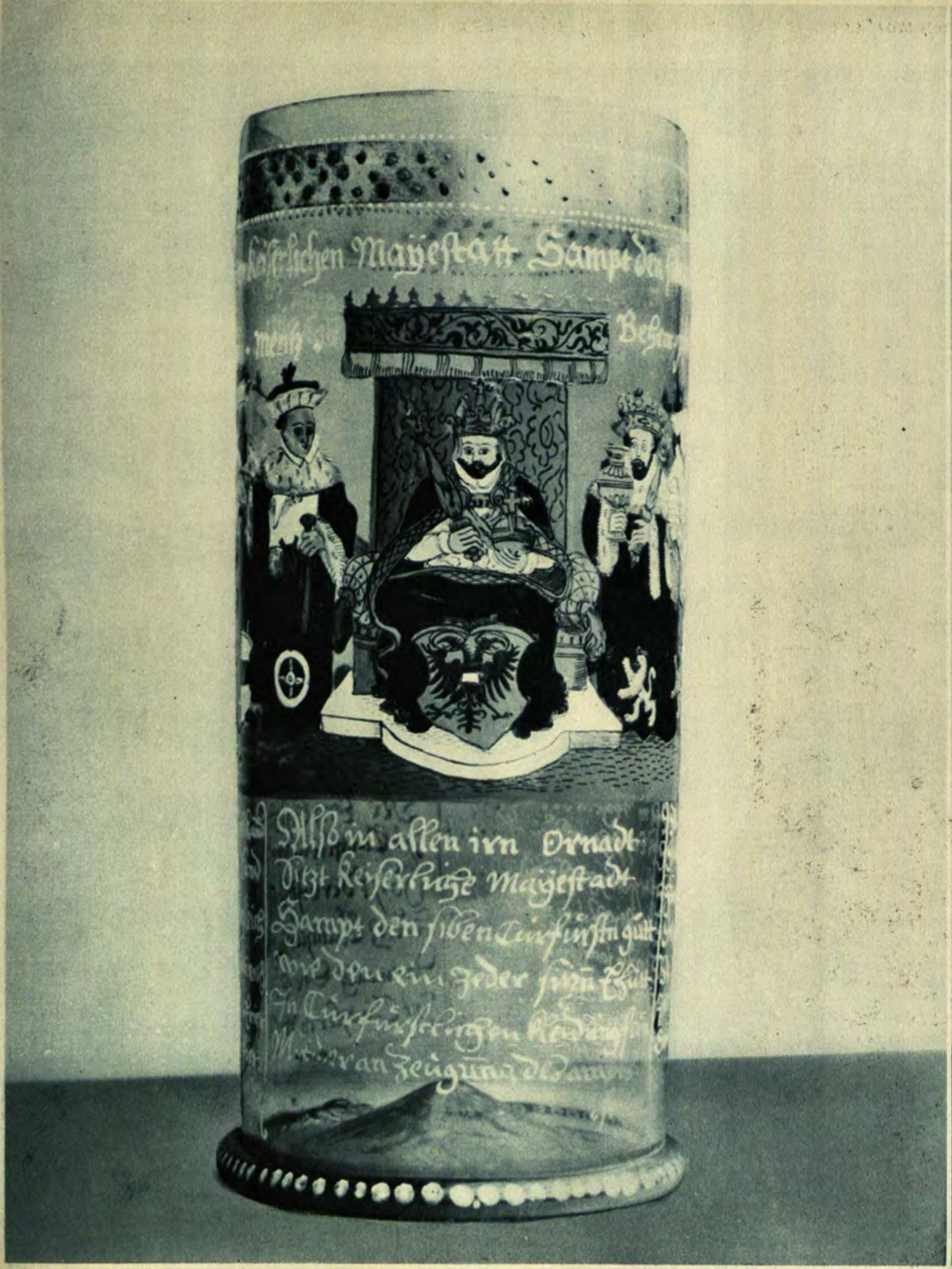
142. Glass with Escutcheon, Enamel-Painted. Castle Buchlov. (PACM) *143. Glass Belonging to Albrecht von Wallenstein, with Enamel-Painted Escutcheon.* *144. Glass Belonging to Vratislav of Pernštejn. Before 1582. Castle Buchlov. (PACM)*



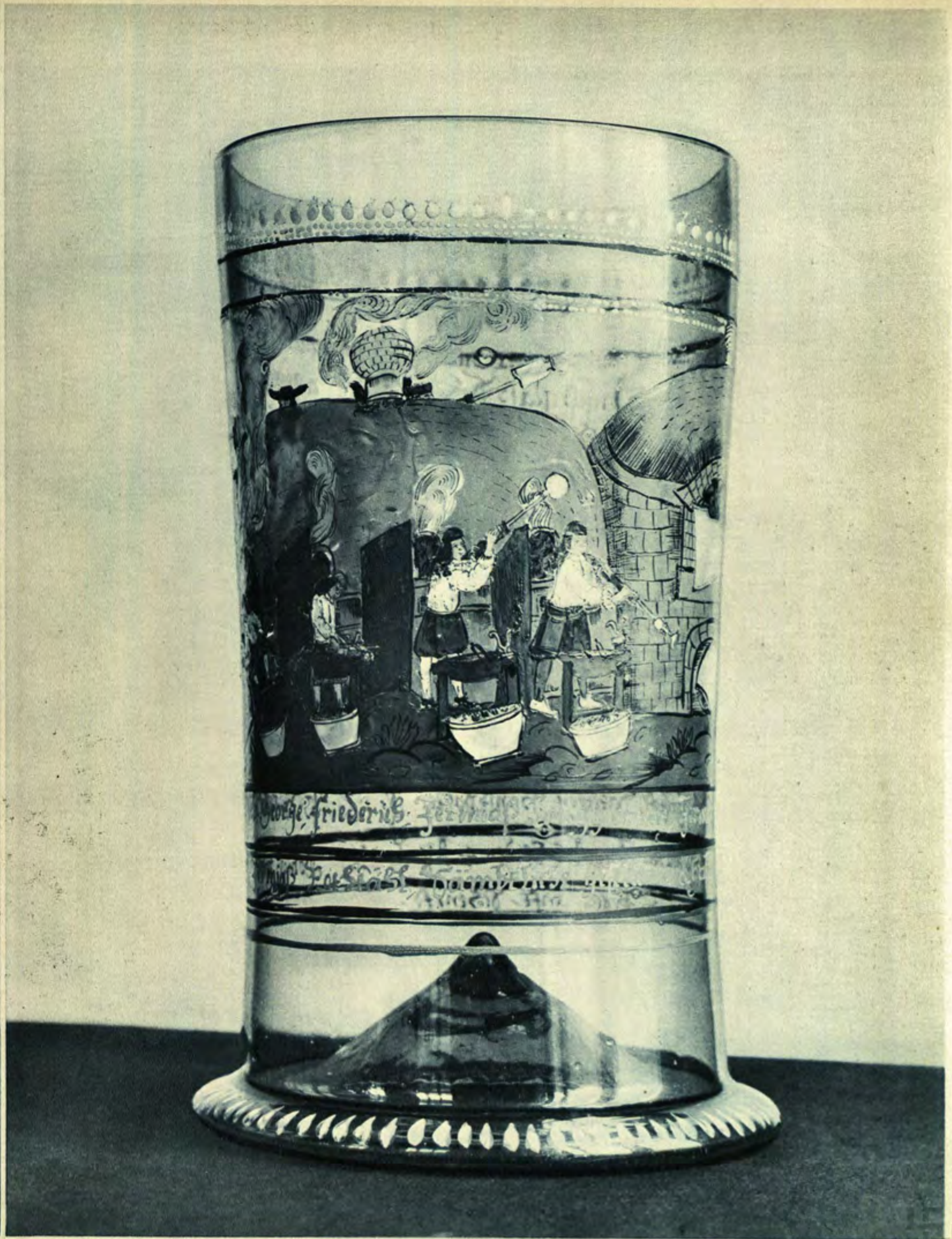
145. Glass with Enamel-Painted Escutcheon of the Family of Schönberg-Einsiedel. Bohemia 1585. (PACM)



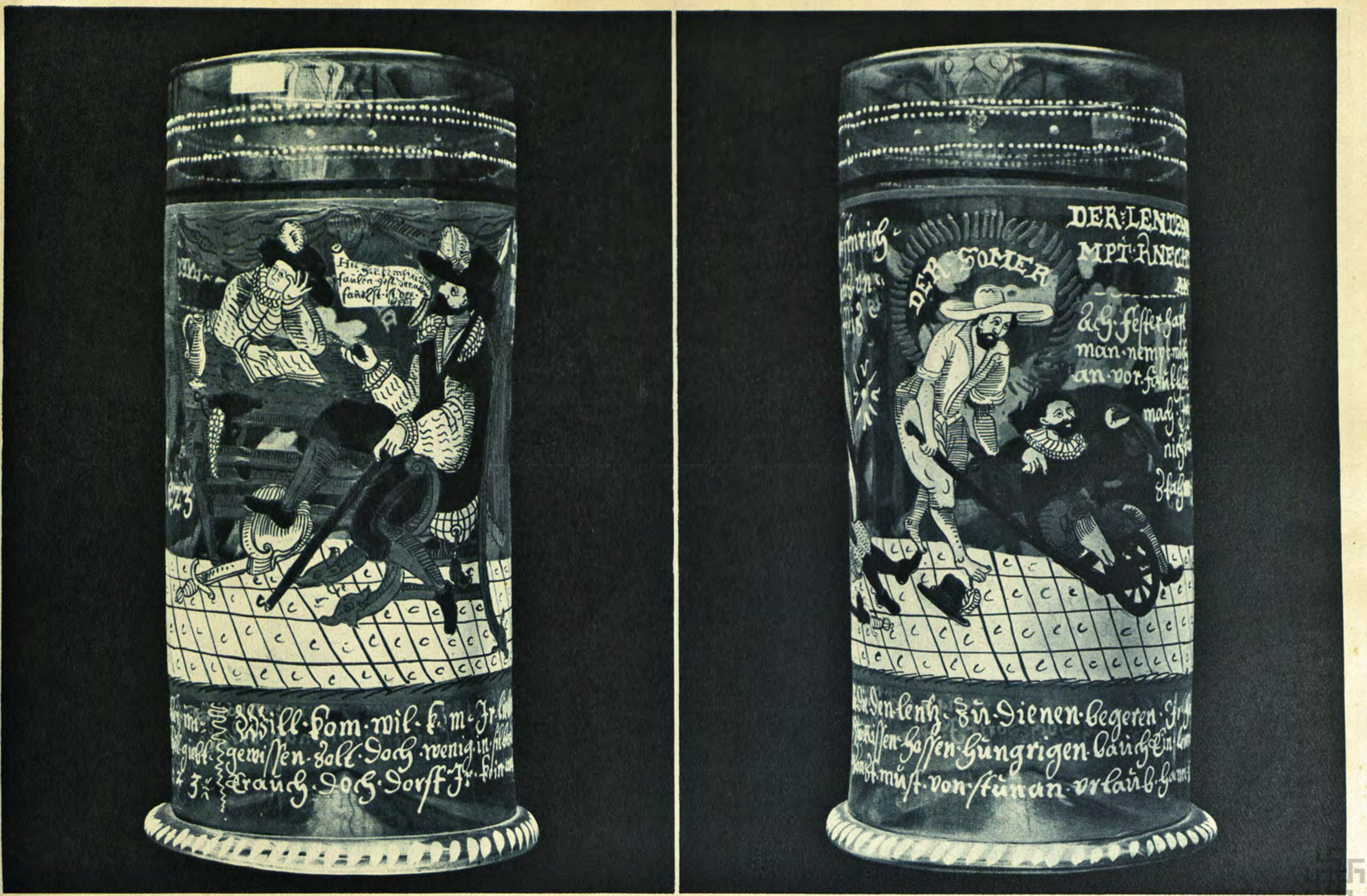
146. Enamel-Painted Glass Ascribed to Christian Preussler. 1680. (PACM)


kaiserlichen Mayestatt Sampt den
Also in allen irn Ornadt
Sitzt keiserliche Mayestadt
Sampt den siben Curfursten gut

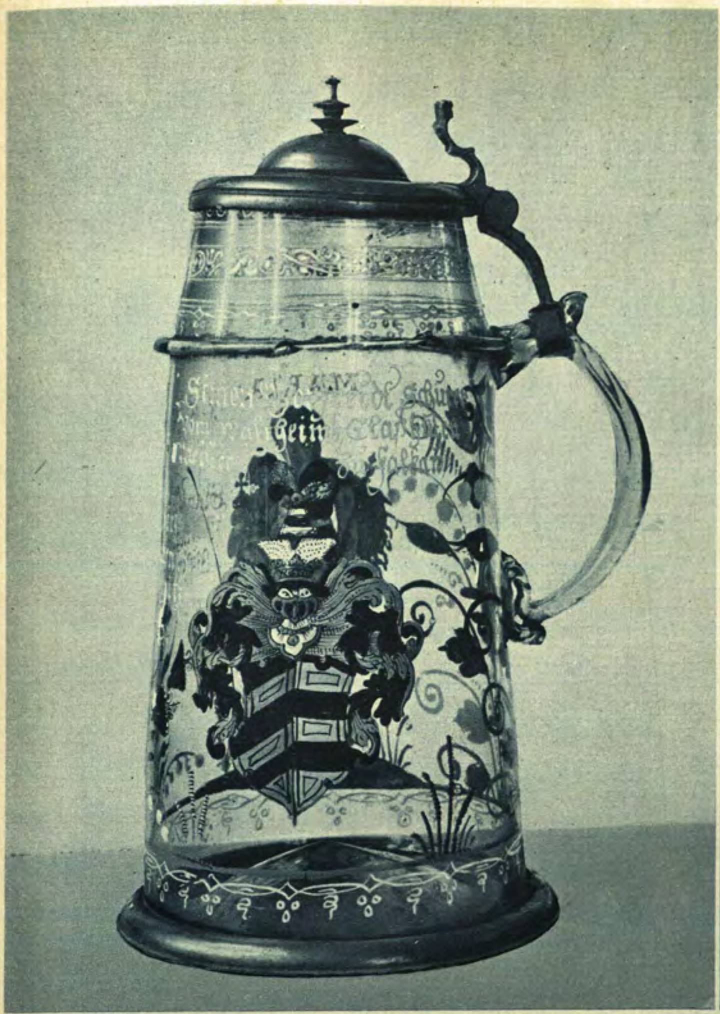
147. Enamel-Painted "Elector" Beaker, Bohemia, 1953. (PACM)

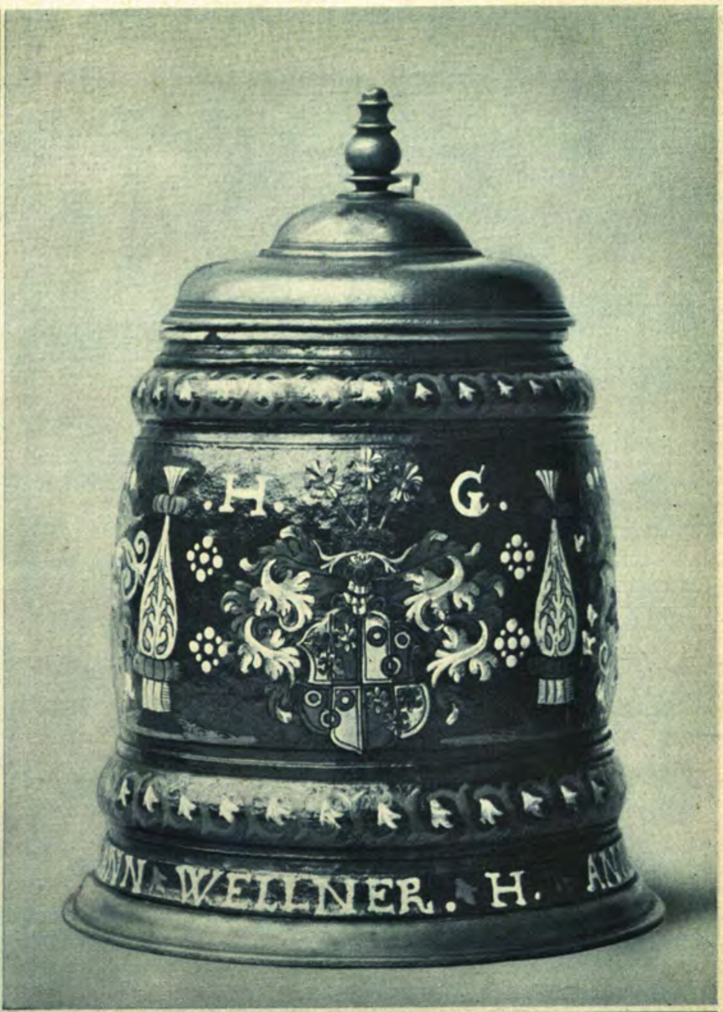


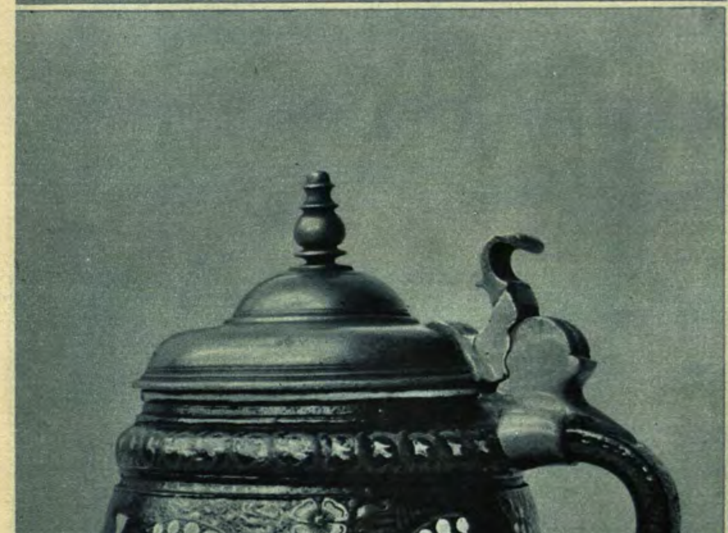
148. Enamel-Painted Drinking Vessel by Chr. Preussler, Representing a Silesian Glass-House. 1680. (PACM)

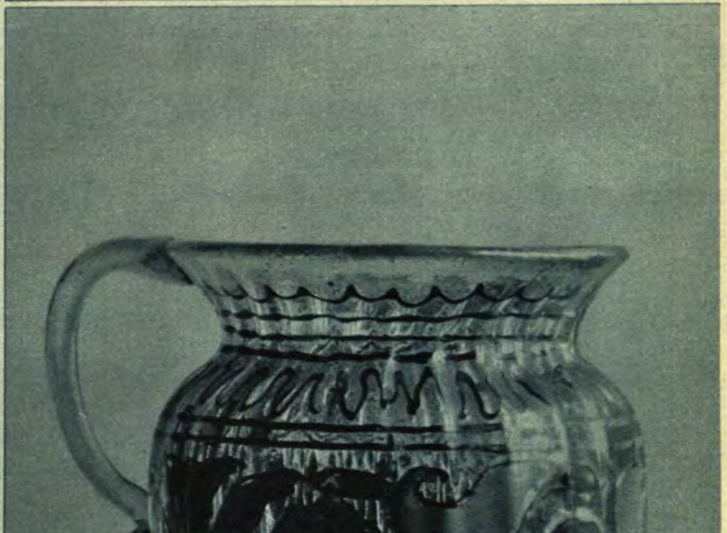


149.—150. *Two Enamel-Painted Beakers from the Cluny Museum, France. Collection of Count Wilczek.*

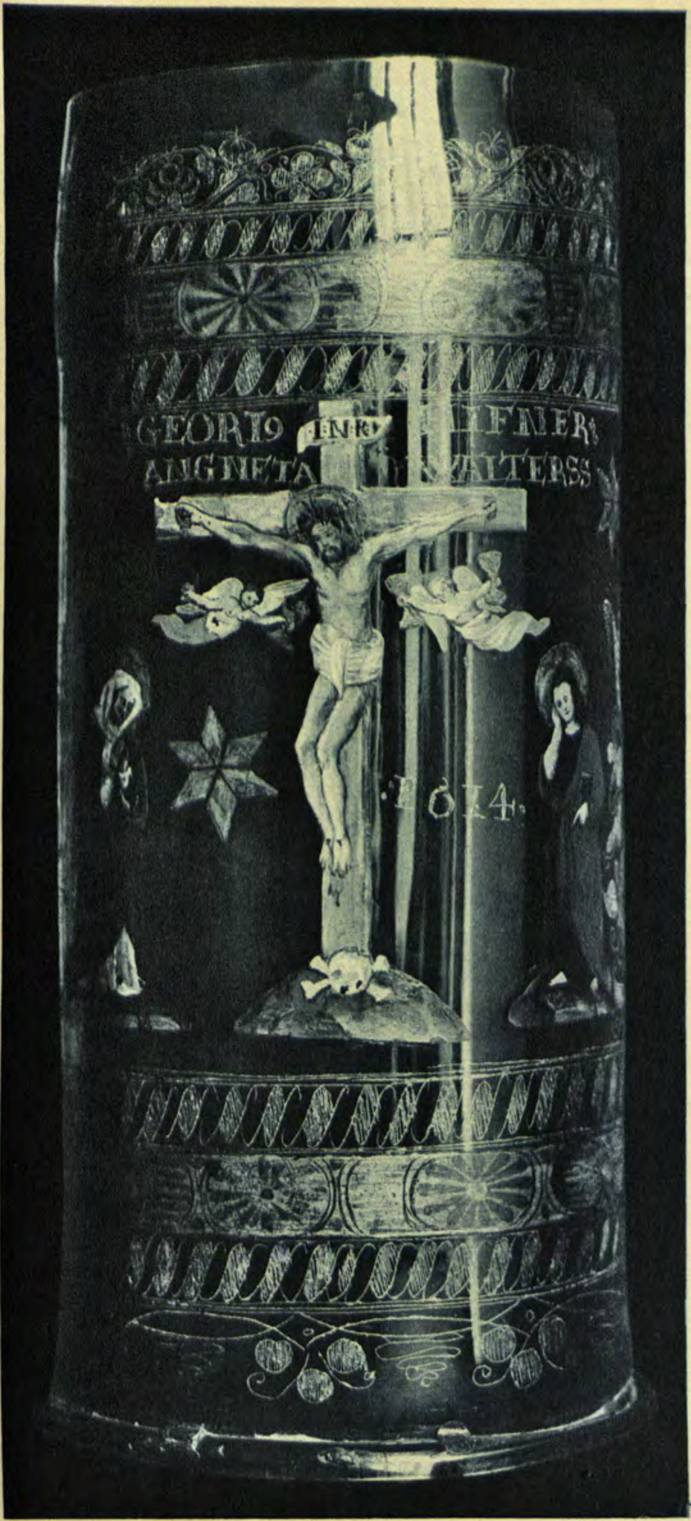


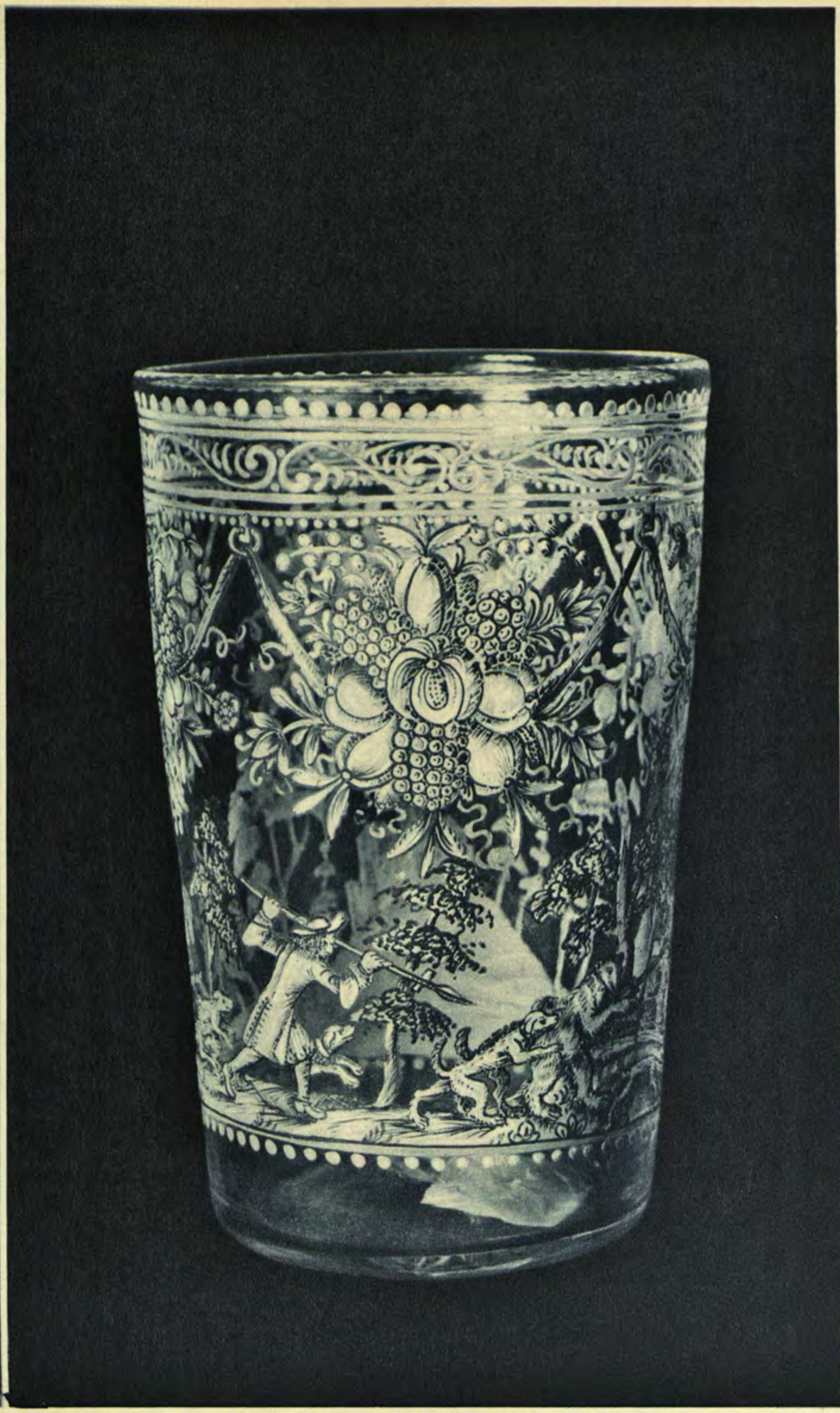


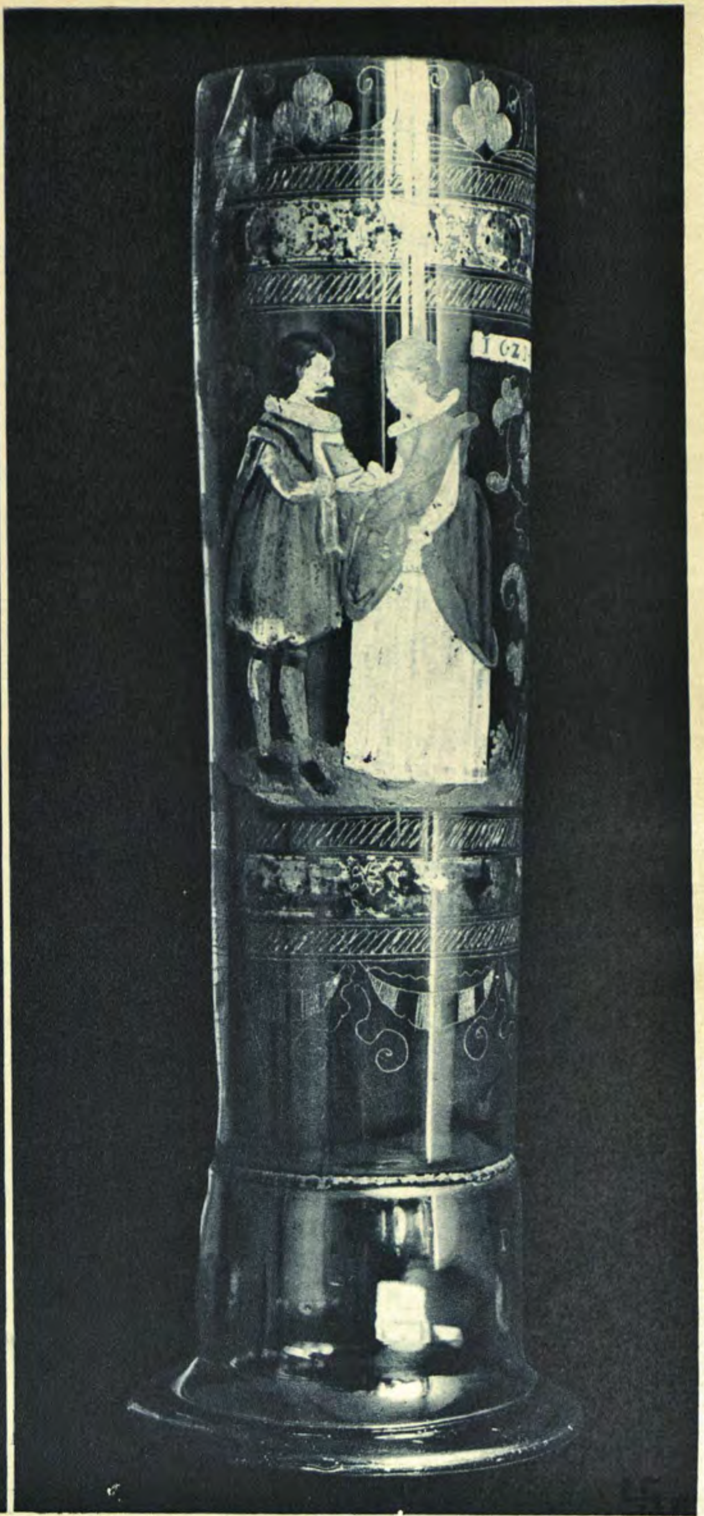




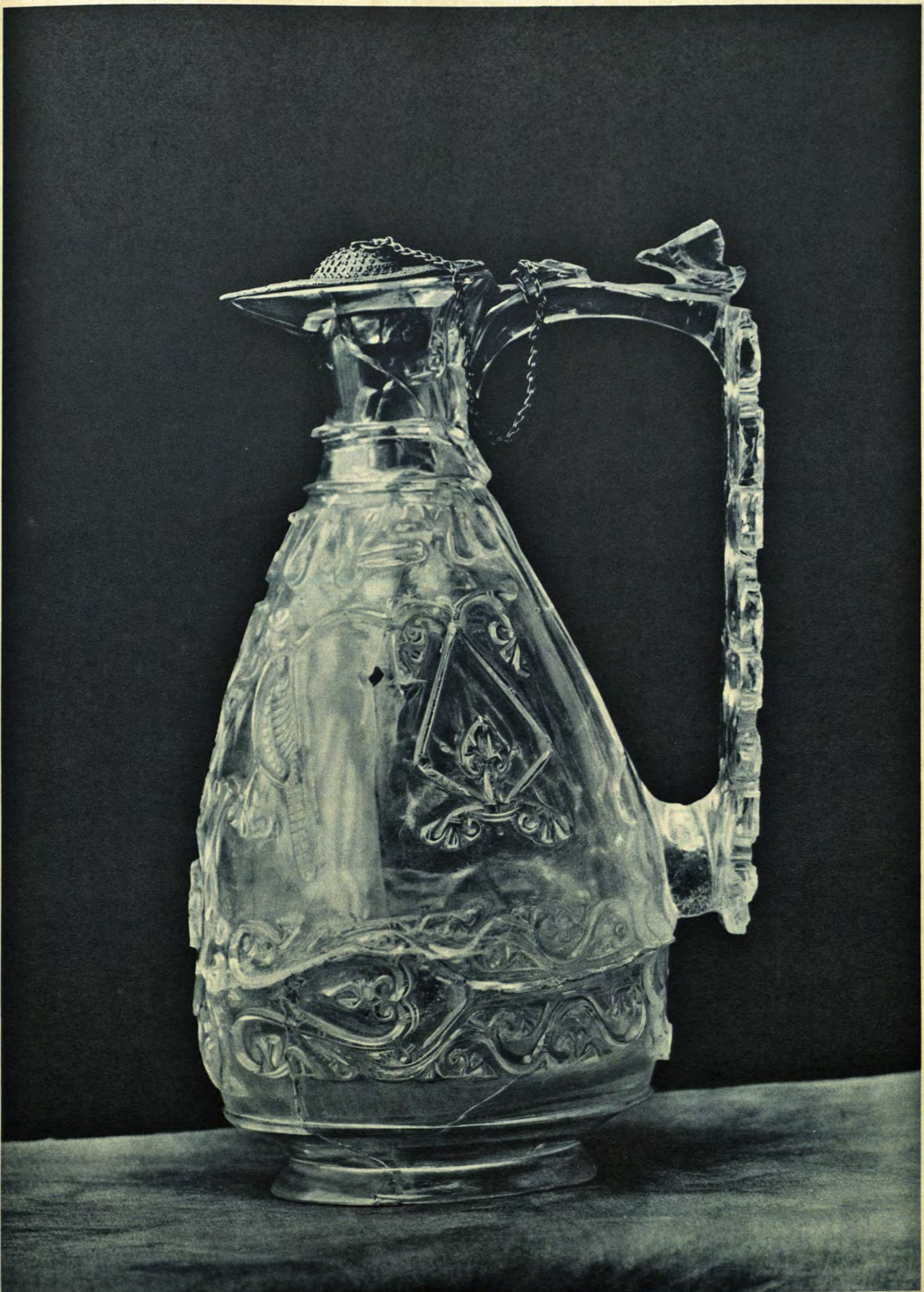
151. The Coat-of-Arms of the Schürers of Waldheim on a "Madonna" Jug. Falkenau, North Bohemia, 1647. (PACM) 152.—153. Example of Enamel-Painting on an Earthenware Jug, Wellner, 1628. (PACM) 154. Enamelled Glass Jug, End of the 16th Cent. City Museum, Prague.



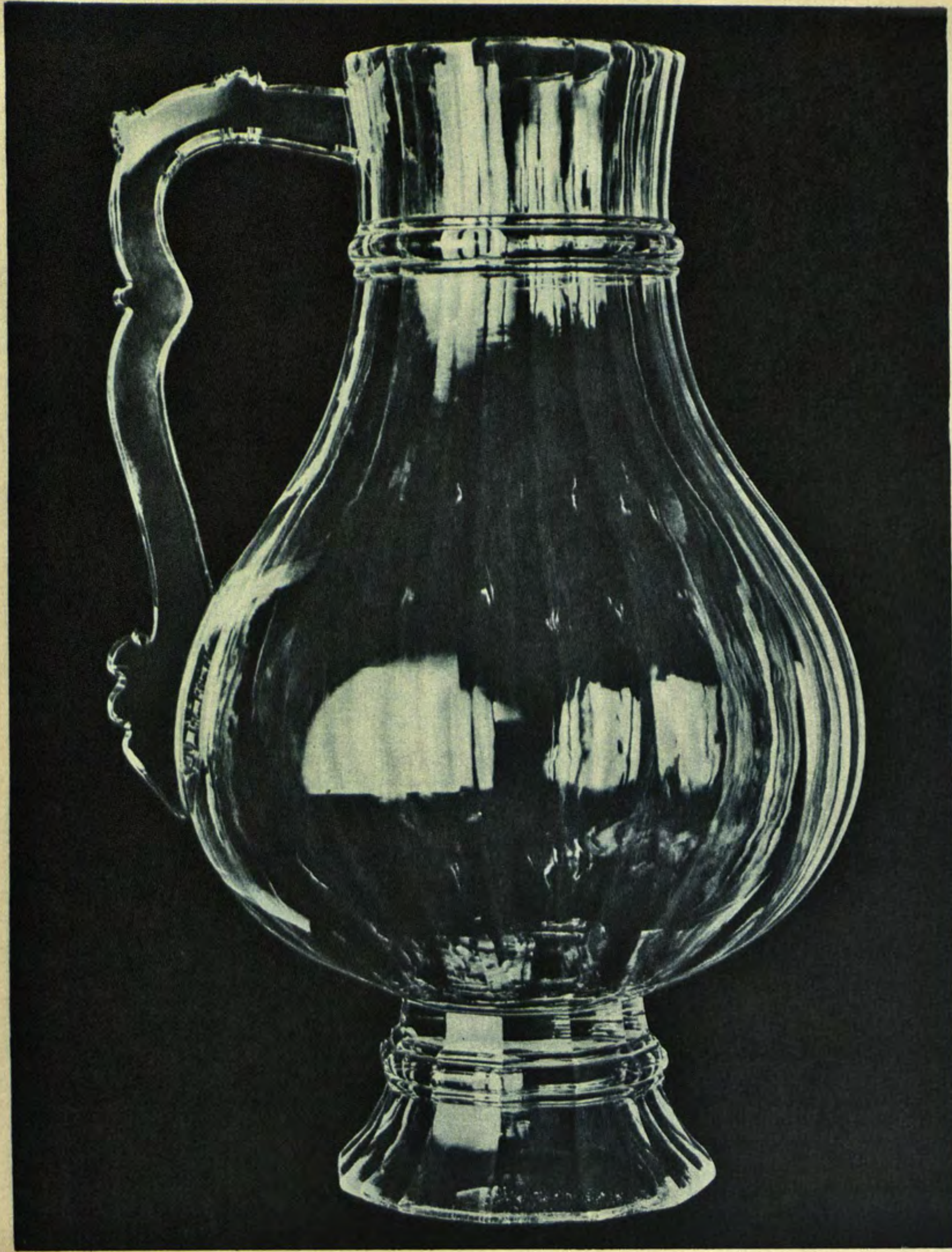




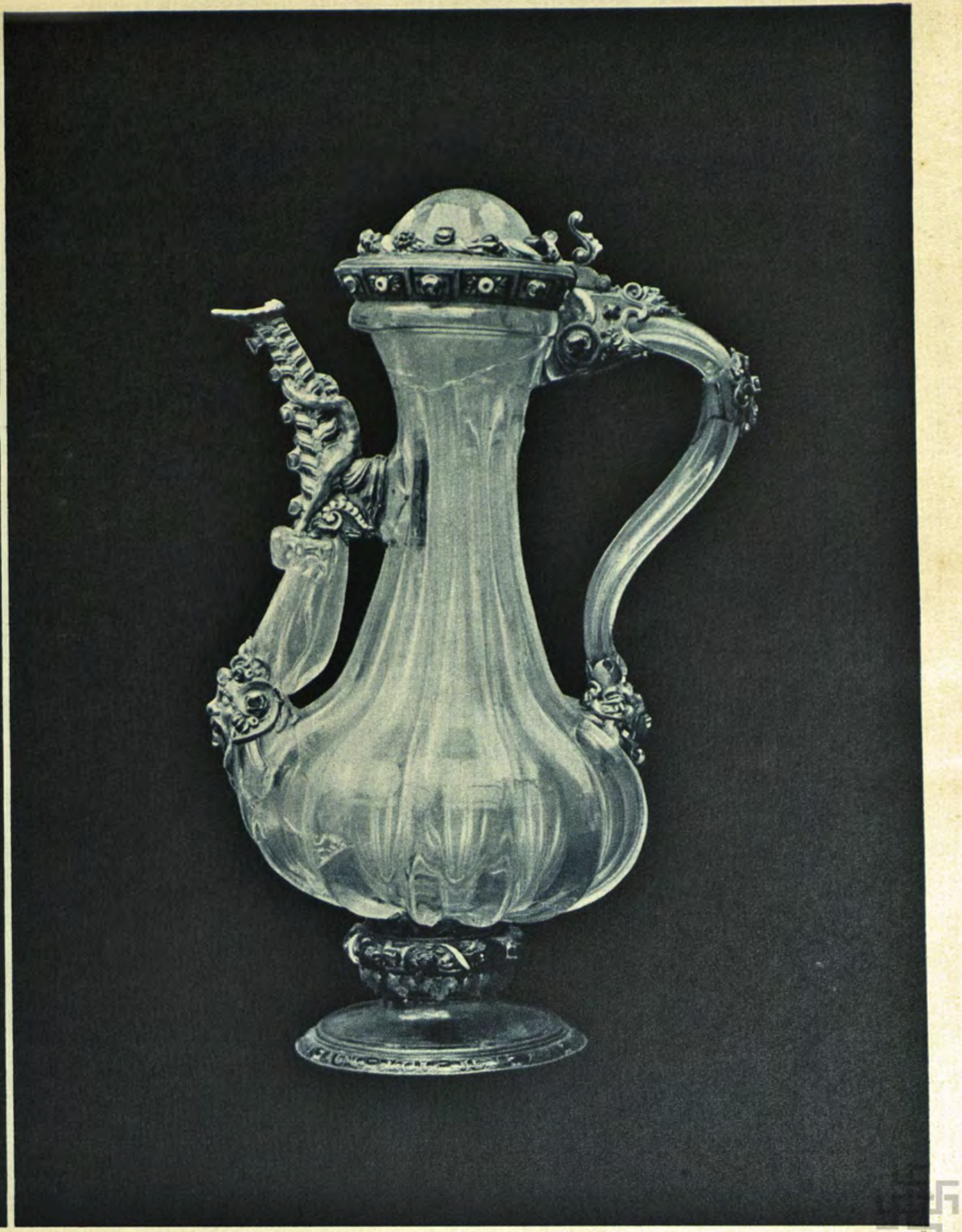
155. Beaker with Diamond Engraving, Painted by the Cold Method, Representing the Crucified. 1614, Germany. (PACM) 156. Decorations in White Enamel on a Beaker, Bohemia, 17th Cent. Castle Museum at Roudnice. 157. South Bohemian Beaker, Diamond Engraving, Oil Painting. 1621. (PACM)



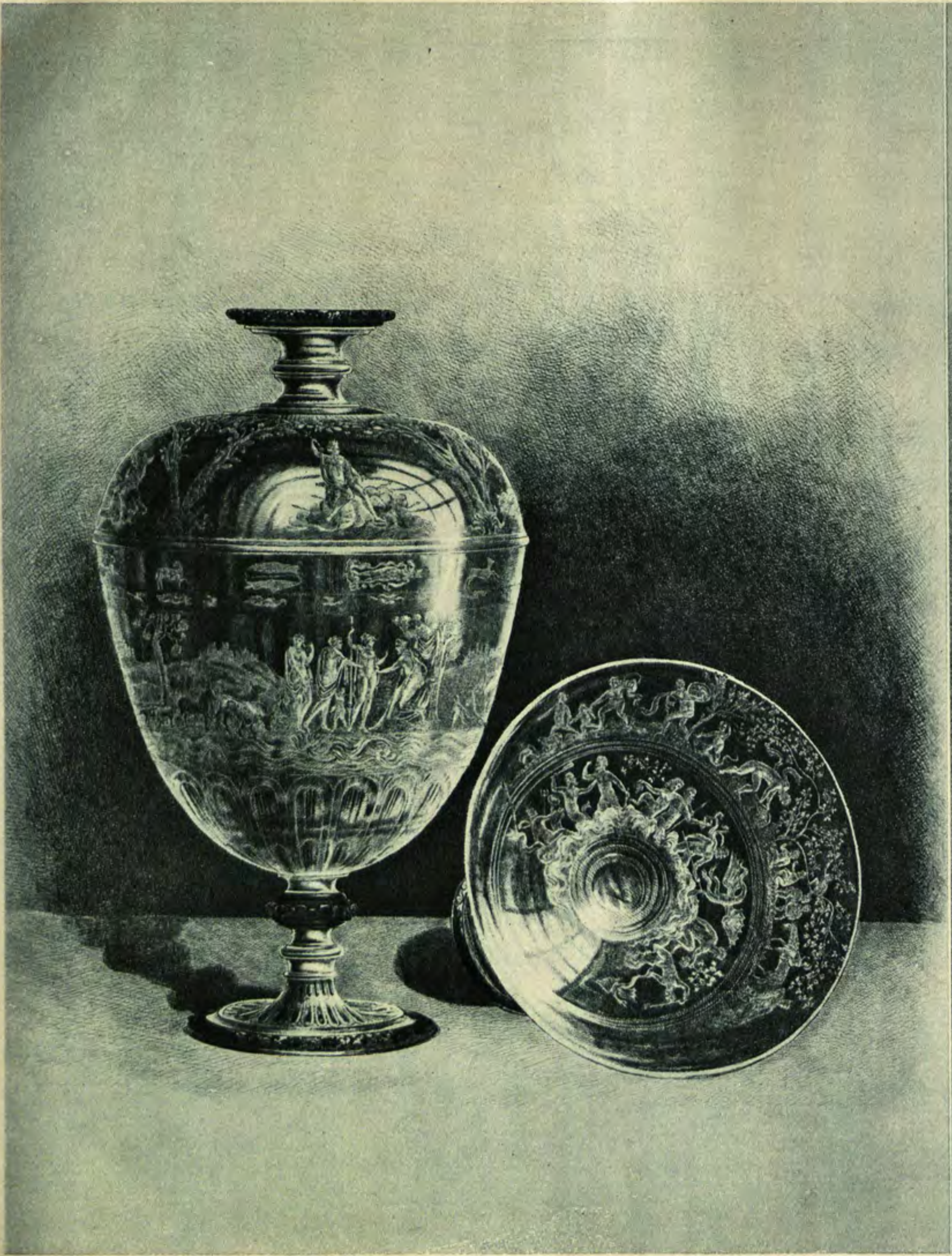
158. Oriental Jug Cut out of Rock-Crystal. St. Denis Treasury, France.



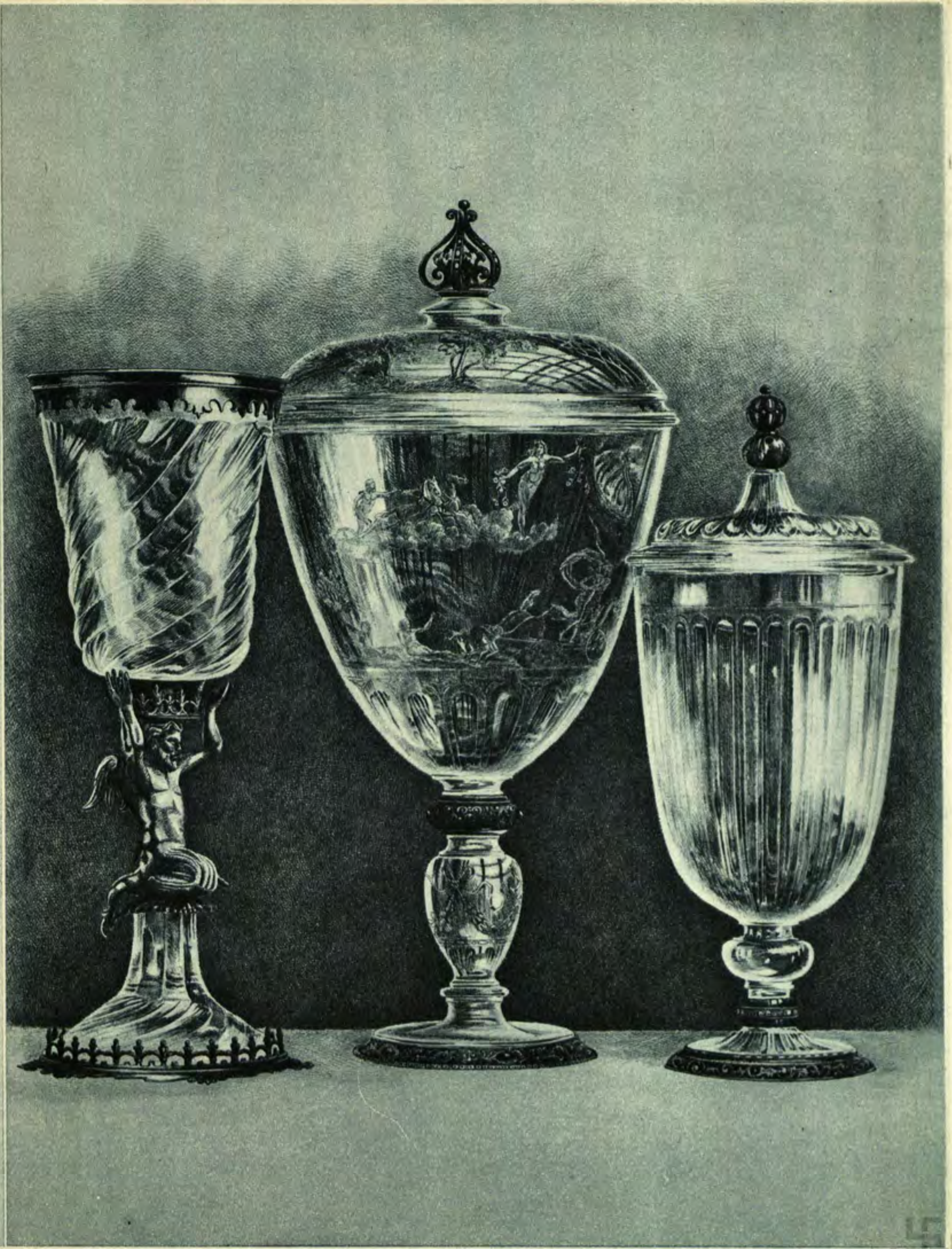
159. *Burgundian Jug of Rock-Crystal. Facet Cut.*



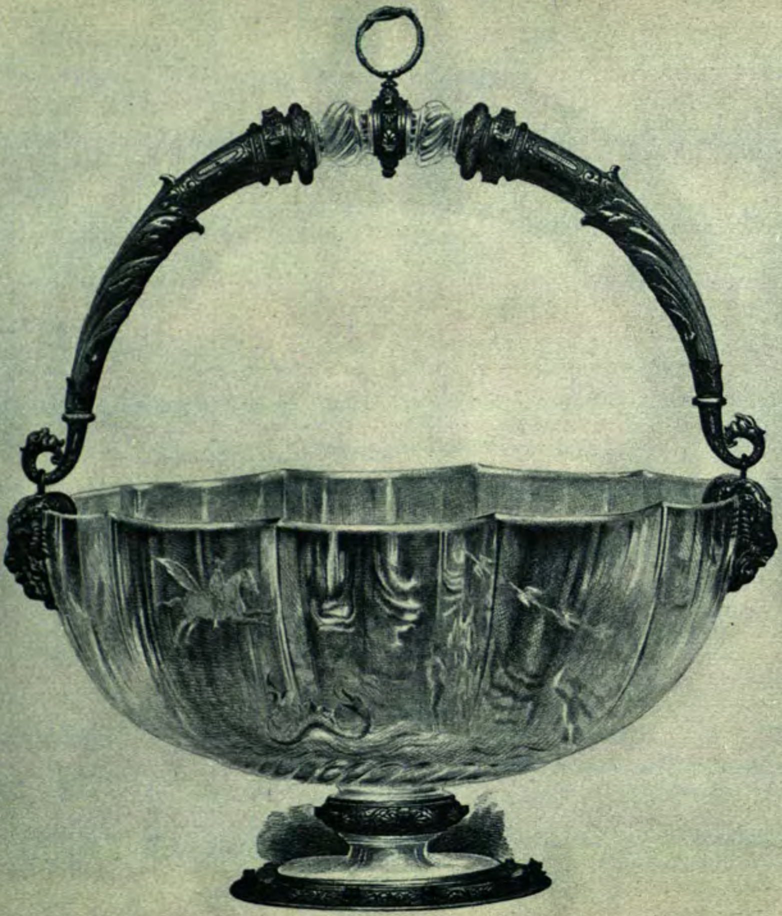
160. *Small French Jug of Rock-Crystal. End of the 16th Cent. Set in Gold.*

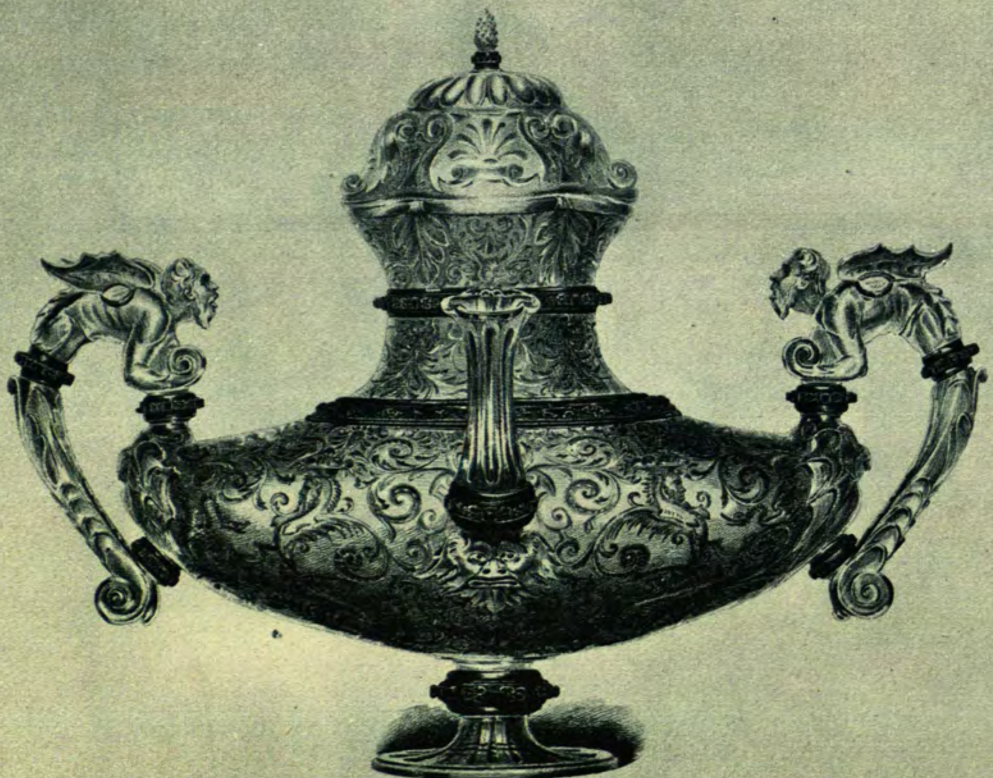


161. *Double Goblet and Cup of Rock-Crystal.*

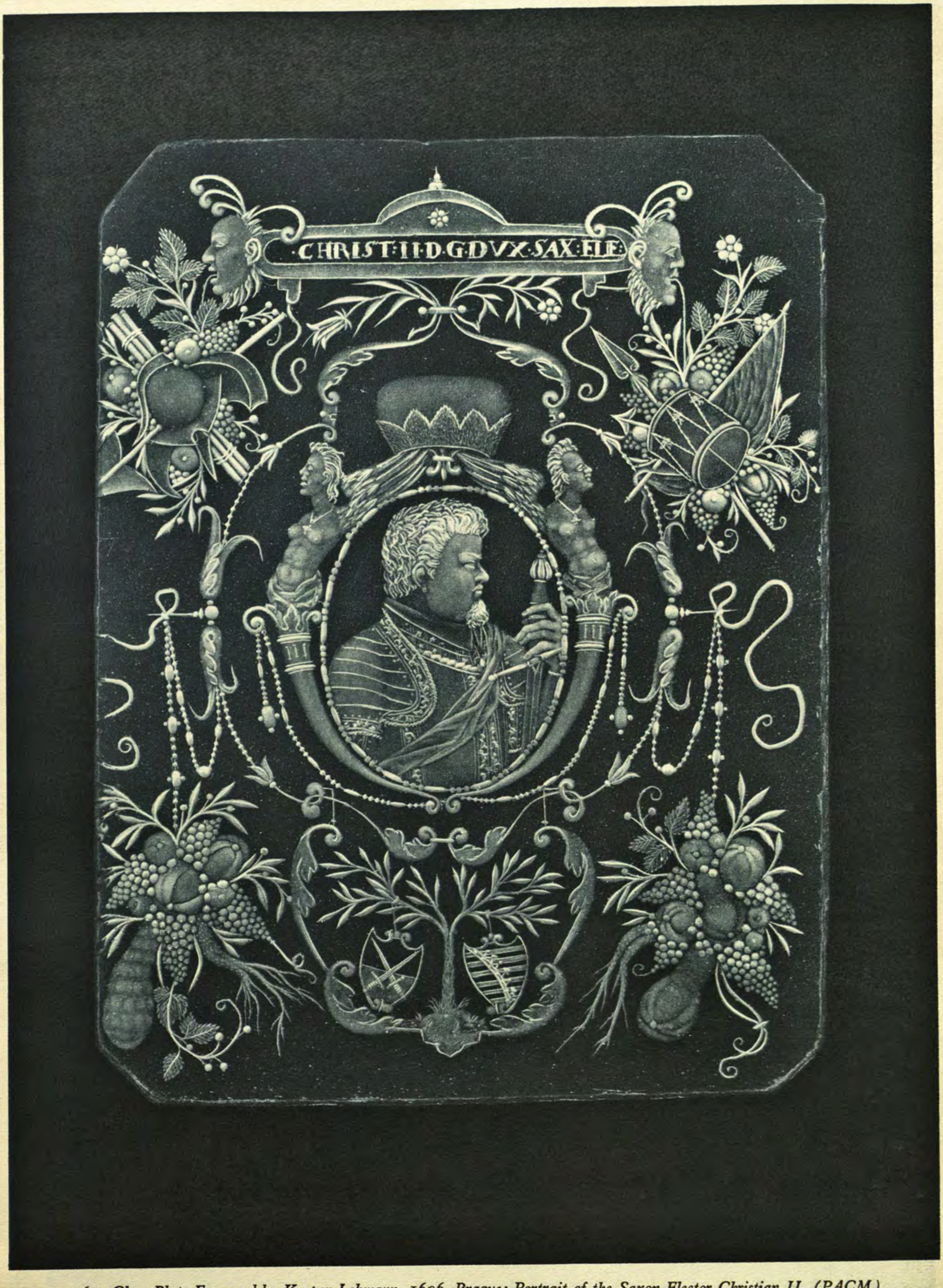


162. *Rock-Crystal Goblets.*

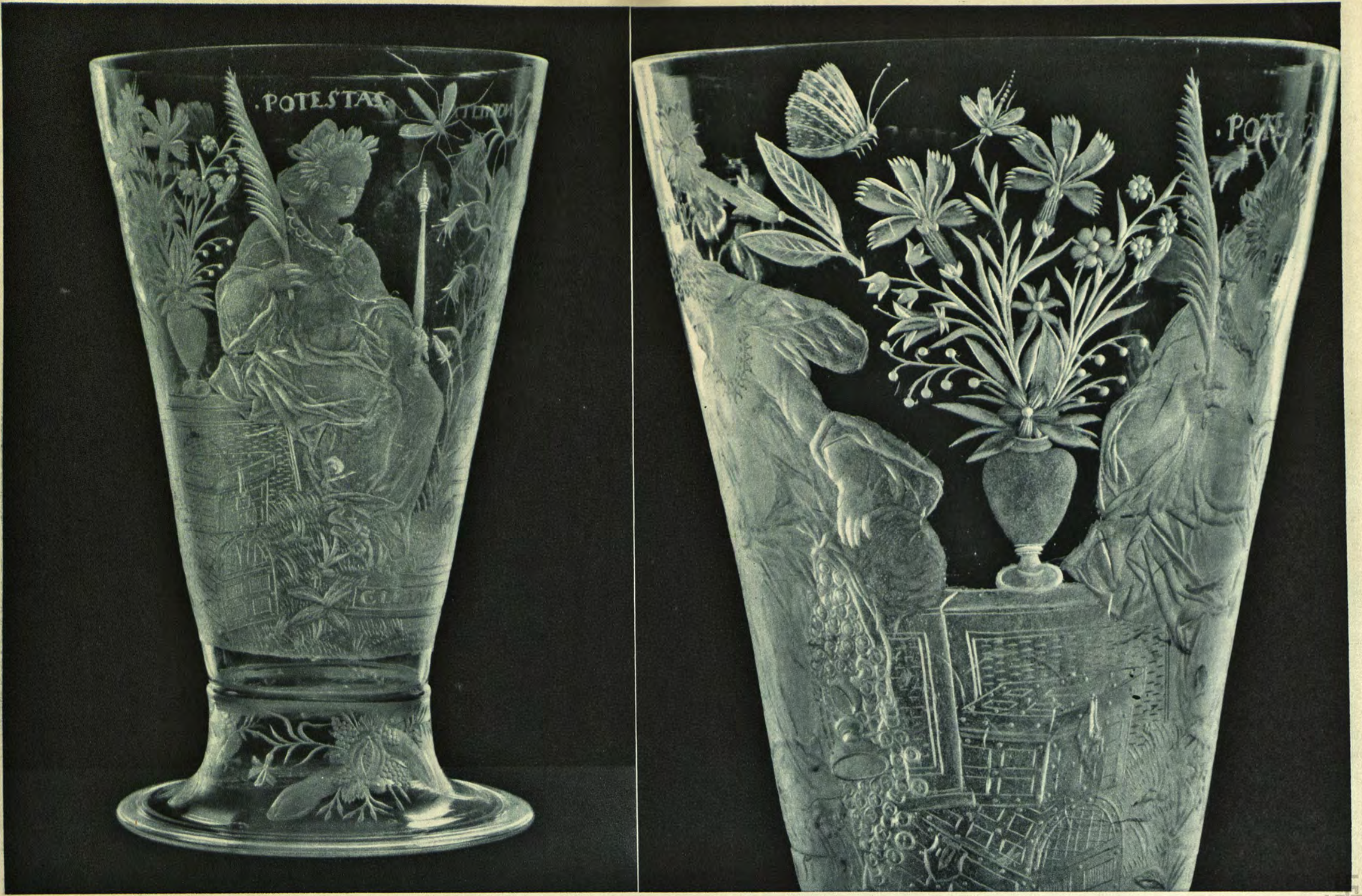




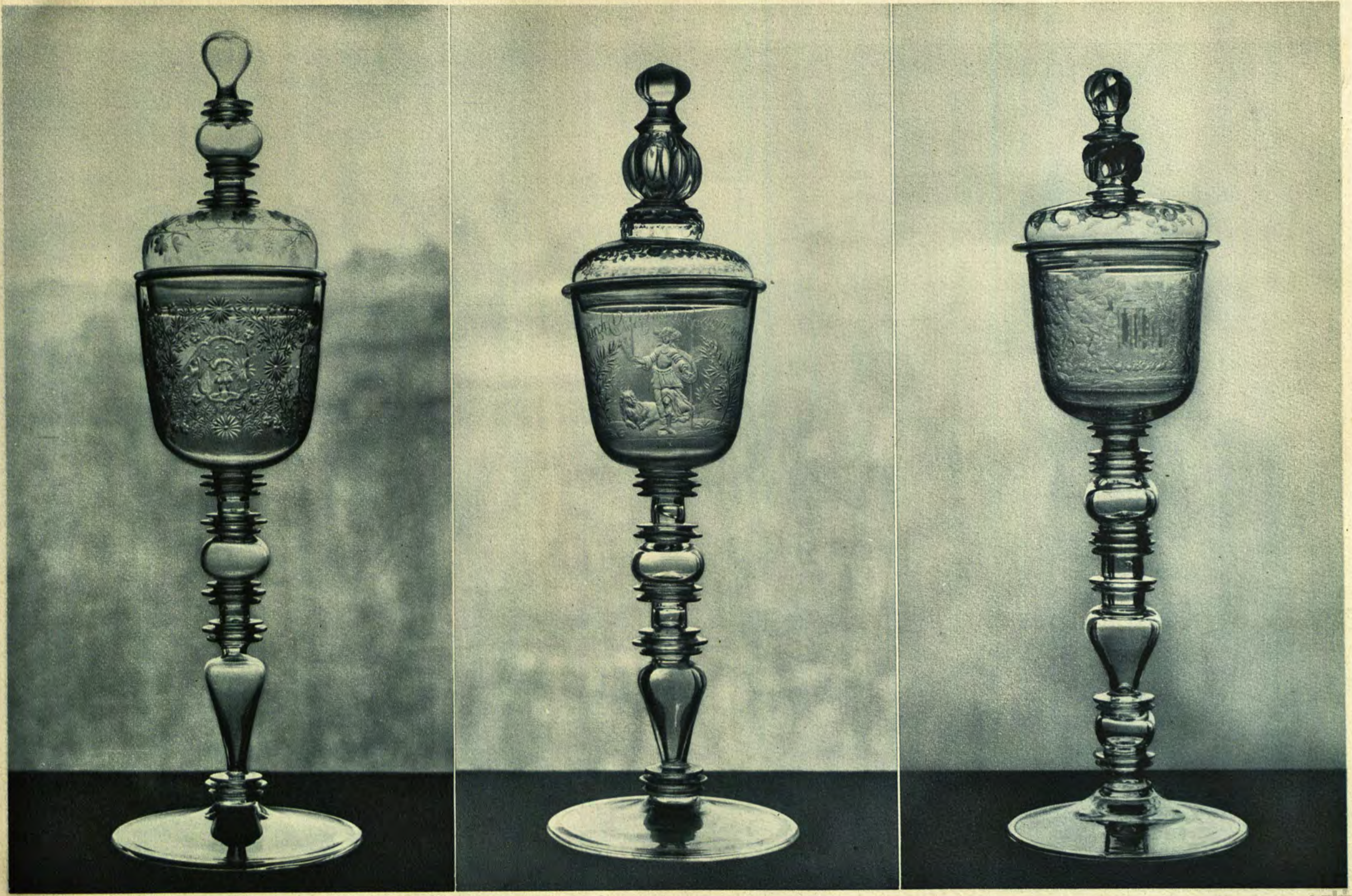
163. Small Rock-Crystal Basket. 164. Small Jug of Rock-Crystal with Spouts on Both Sides.



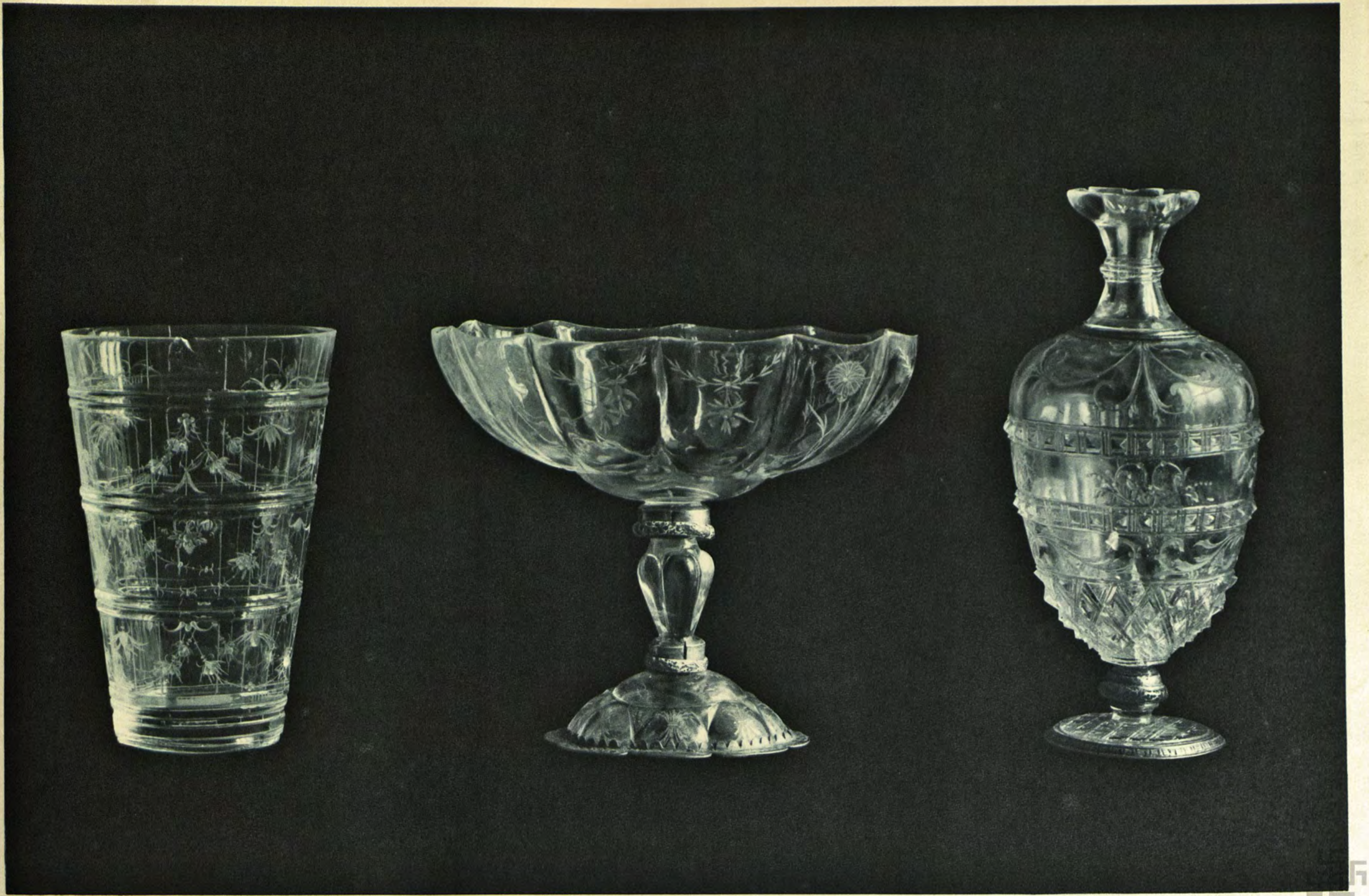
165. Glass Plate Engraved by Kaspar Lehmann, 1606, Prague: Portrait of the Saxon Elector Christian II. (PACM)



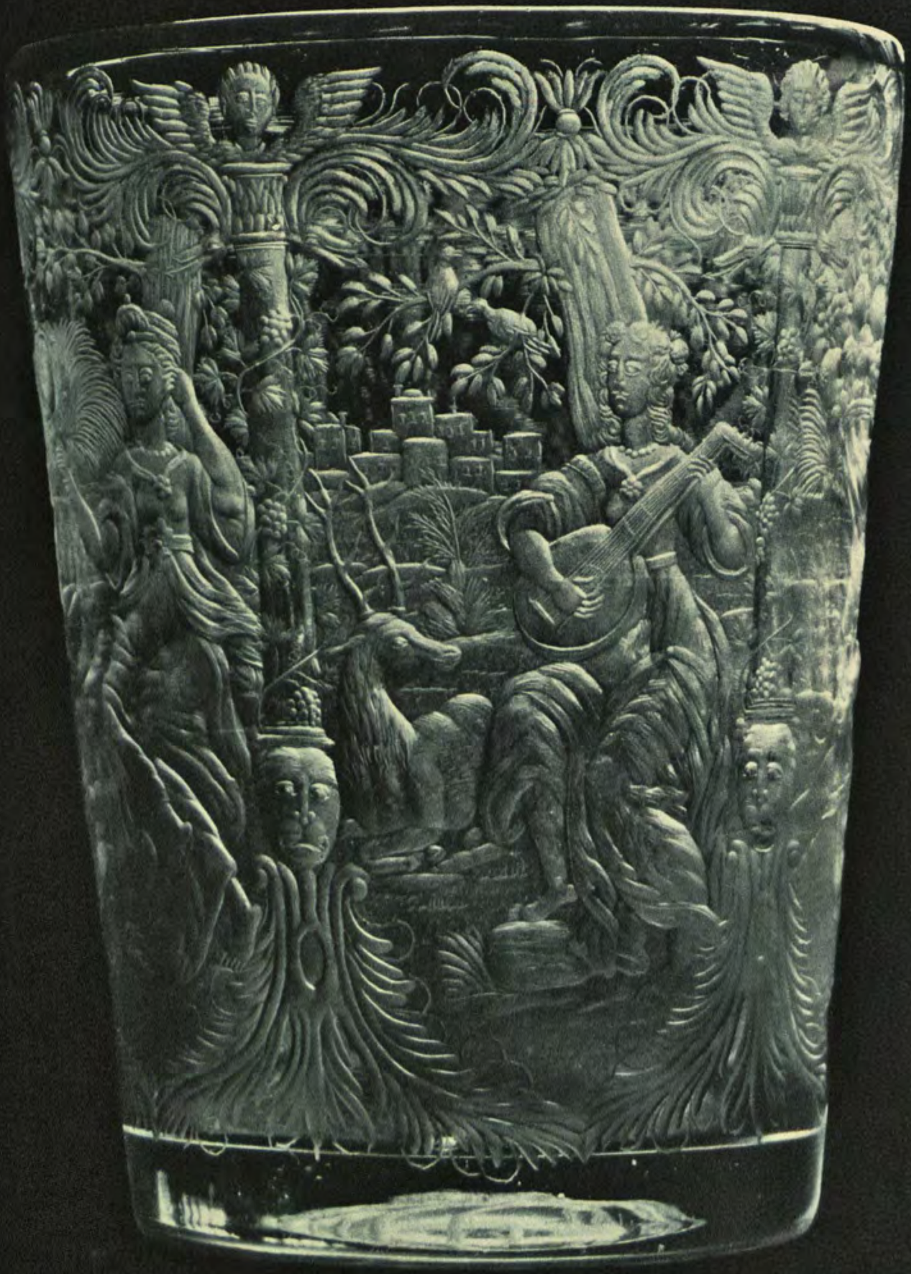
166.—167. *Kaspar Lehmann: Glass with Engraved Decorations According to an Engraving by J. Sadeler, 1597: Potestas and Liberalitas (with the Escutcheon of the Counts of Rogendorf and Losenstein) Bohemia, 1605. Castle Hluboká on the R. Vltava (now PACM). Photo: J. Brok, Prague.*



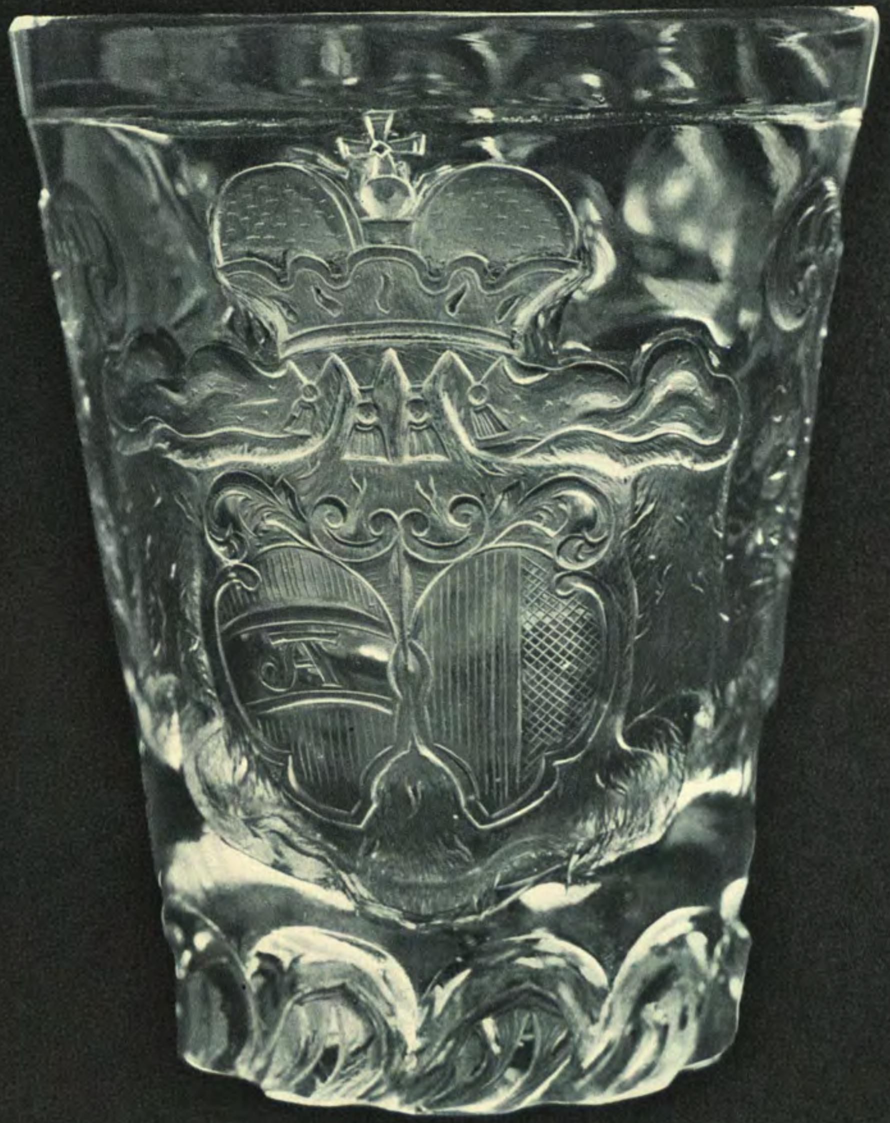
168.—170. *Three Engraved and Cut Nuremberg Goblets from the Second Half of the 17th Cent.* (PACM)



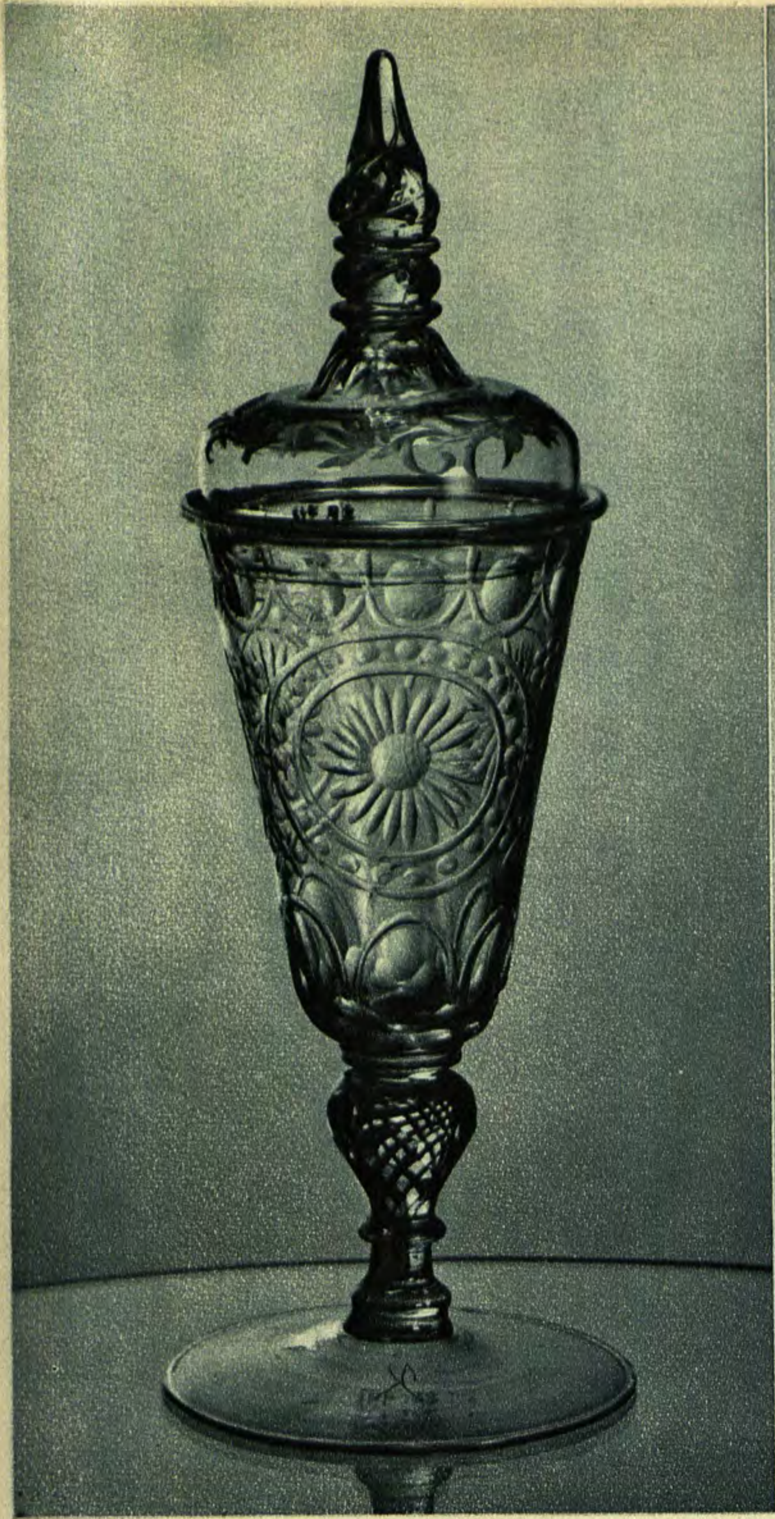
171. *Rock-Crystal Set. Prague, 17th Cent. (PACM)*

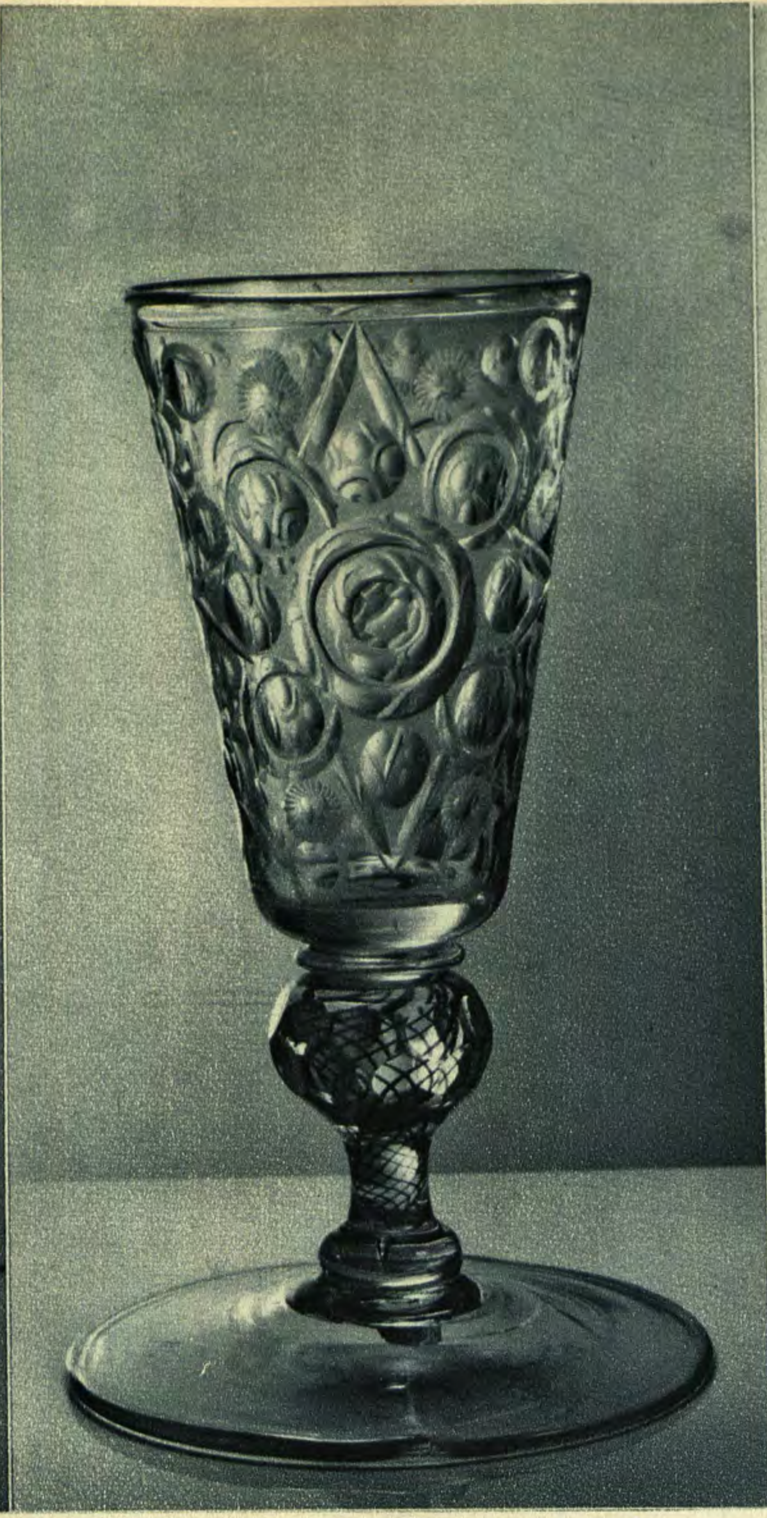


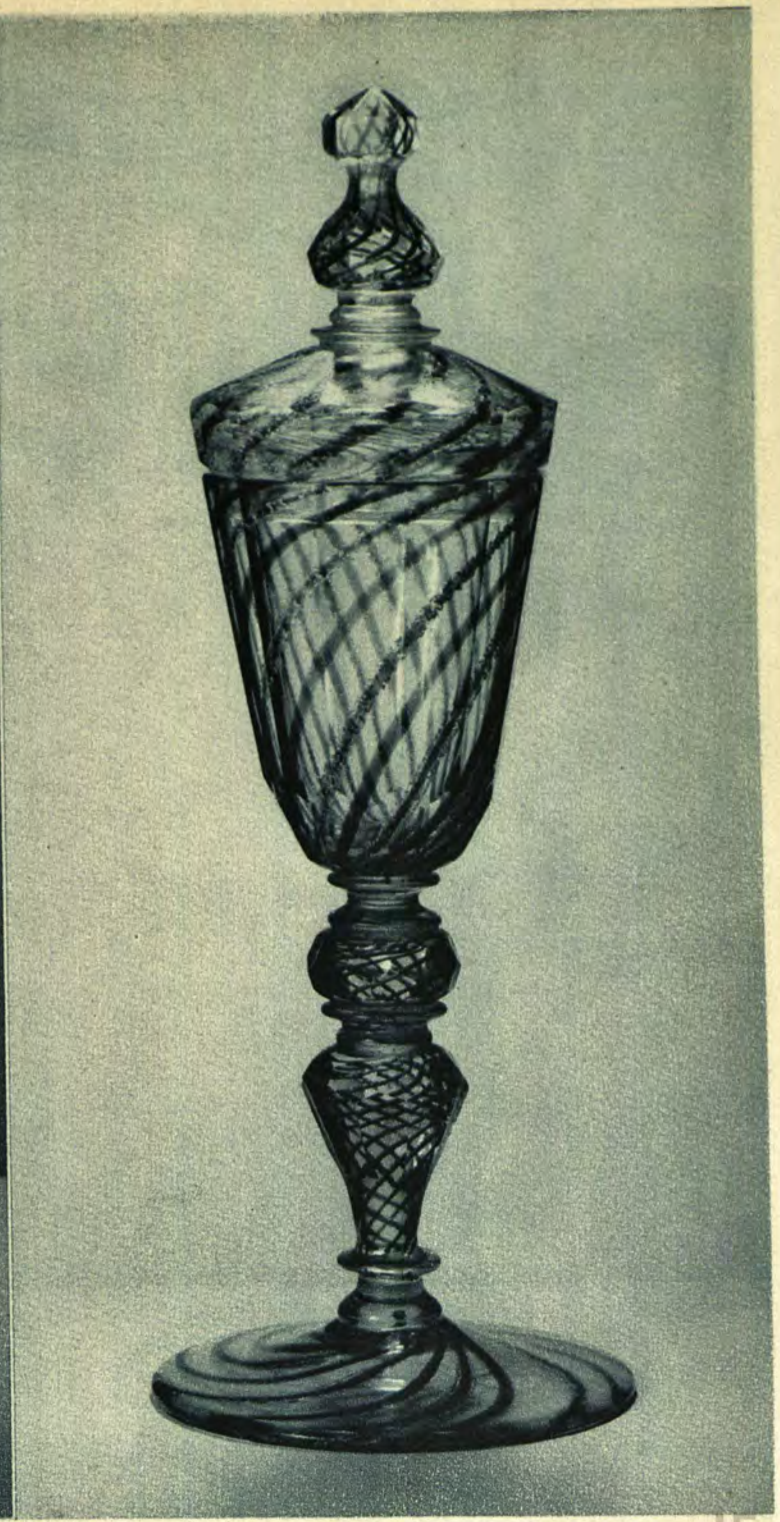
172. *Engraved Glass with the Allegories of the Five Senses (Based on an Engraving by Martin de Vos). Bohemia, Middle of 17th Cent. (PACM)*



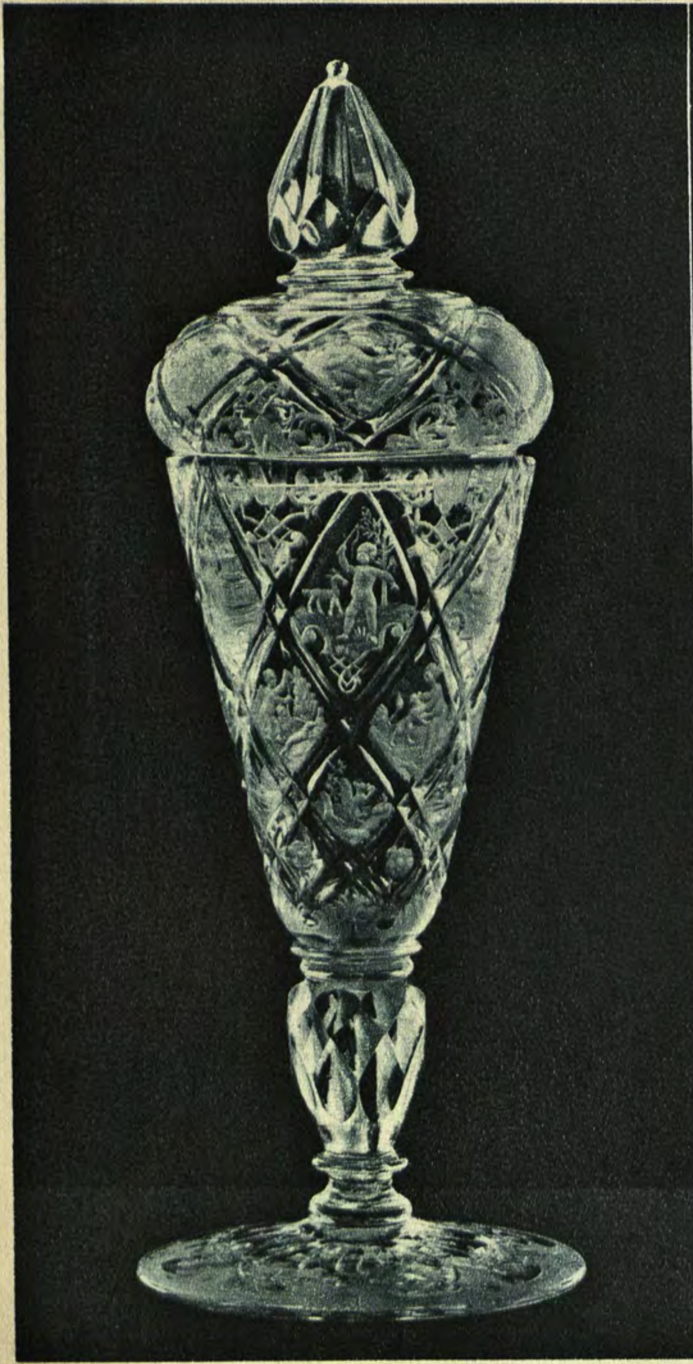
173. *Glass with Bas-Relief and Intaglio Decorations, Showing the Coat-of-Arms of the Alliance of the Magistrate of the County of Kladsko (now Klodzko), M. V. Fr. of Althan and the Countess of Kokořov; probably the work of the Winter Workshop in Petersdorf (now Piotrowice) 1690—1698.*

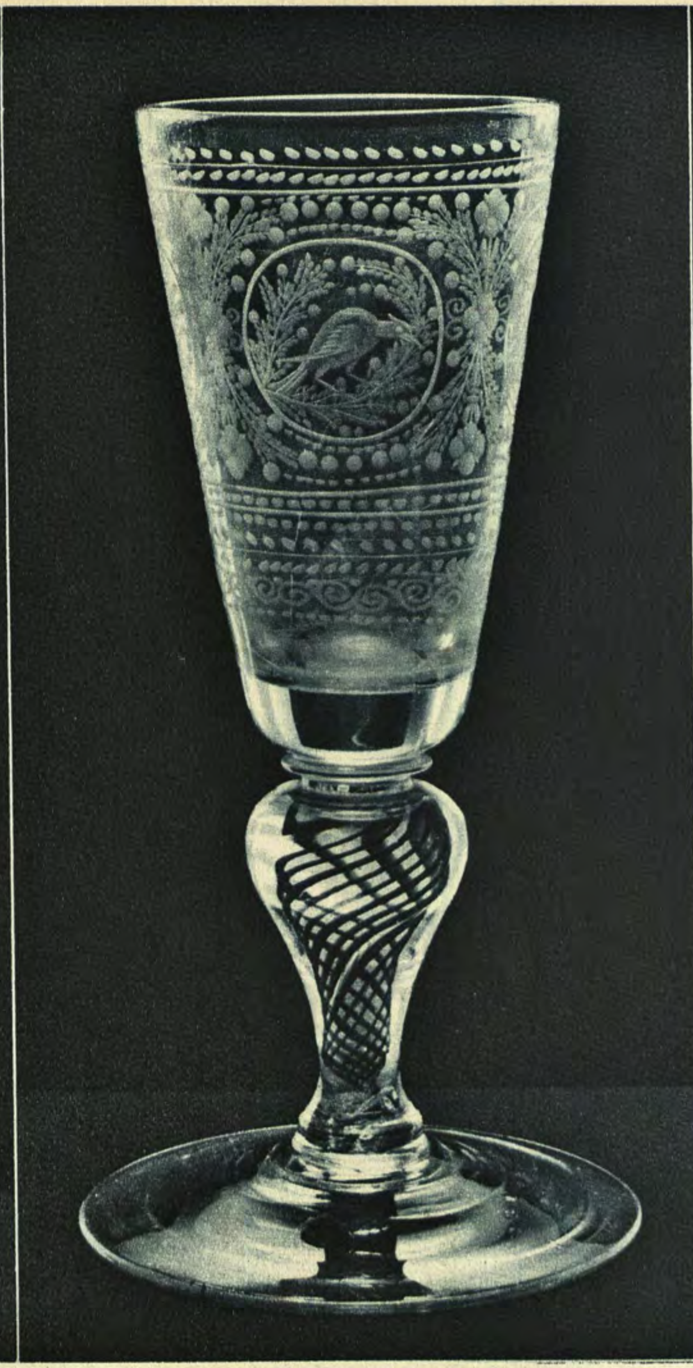


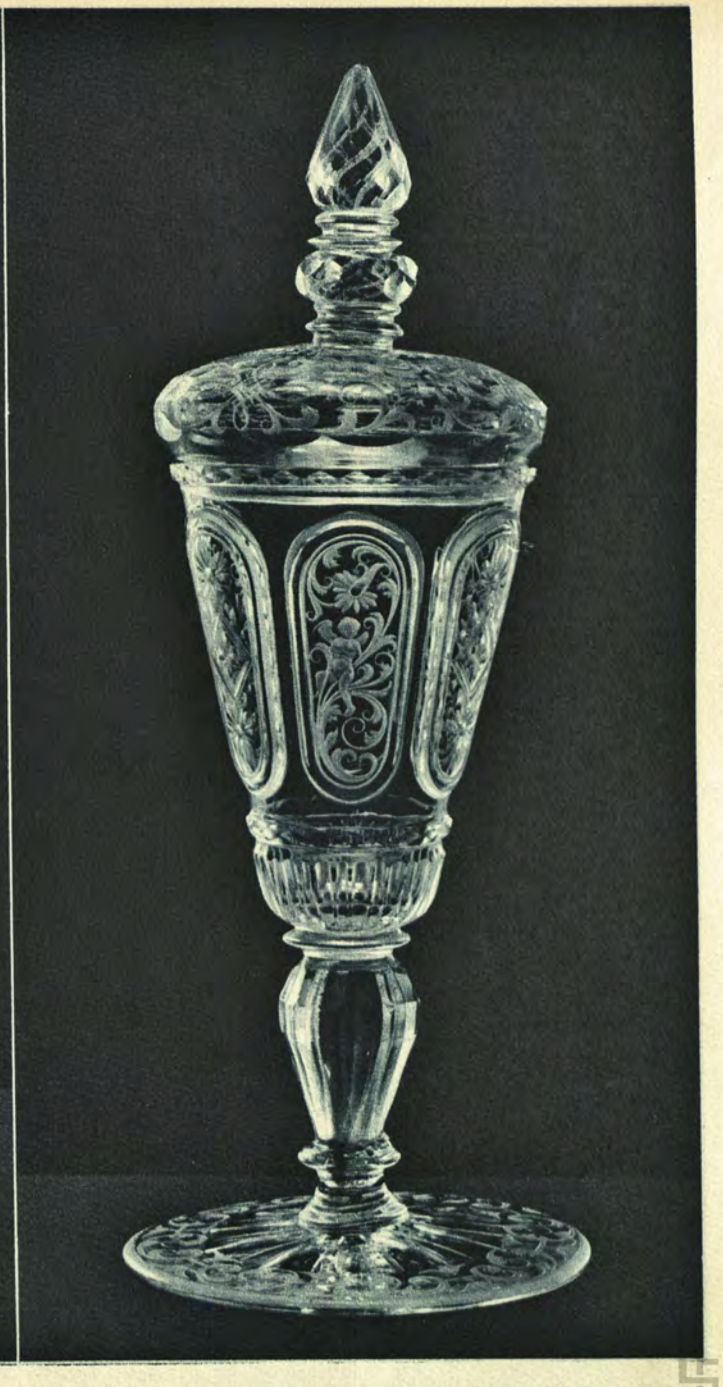




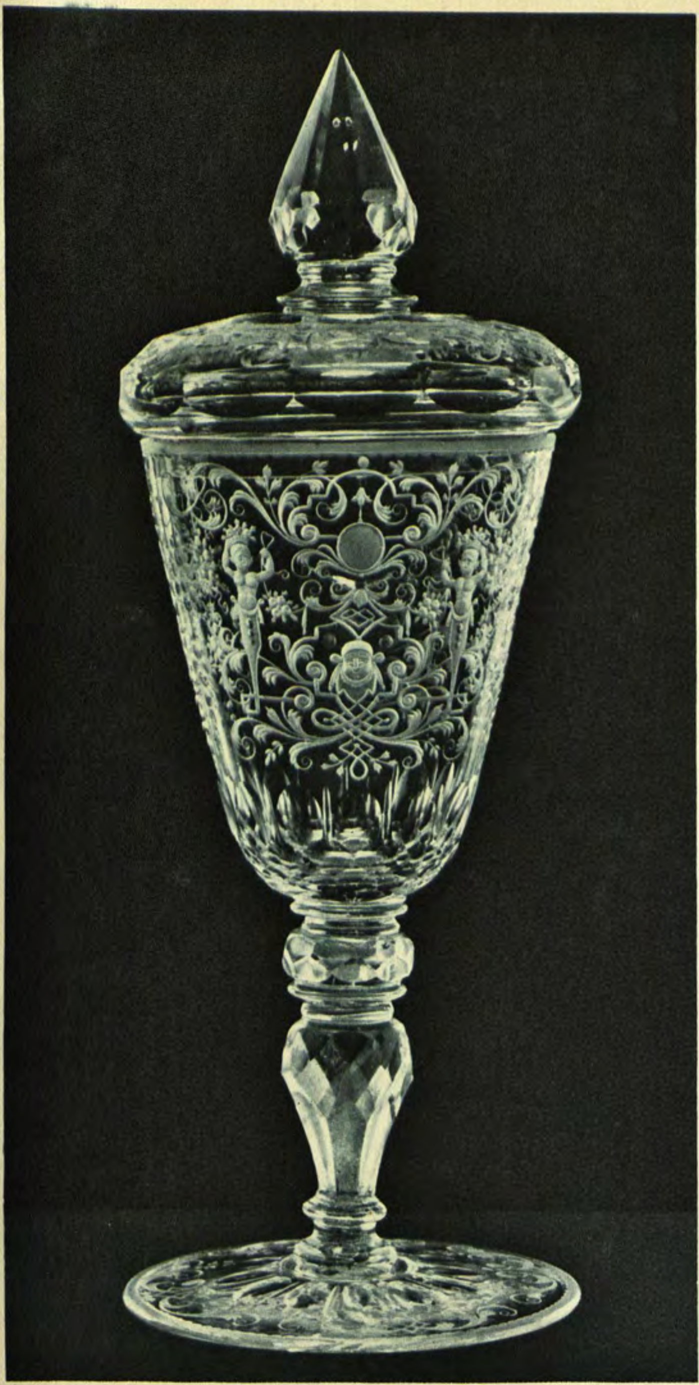
174. Drinking Vessel with Lid. Baroque Work, Cut-Glass with a Ruby Spiral in the Stem. Bohemia, First Half of 18th Century. (PACM). Photo: J. Brok, Prague. 175. Baroque Drinking Vessel, Cut-Glass with a Ruby Spiral Melted in. Bohemia, Beginning of 18th Century. (PACM). Photo: J. Brok, Prague. 176. Baroque Drinking Vessel with Lid. Ruby Threads, Bohemia. First Half of 18th Century. (PACM). Photo: J. Brok, Prague.

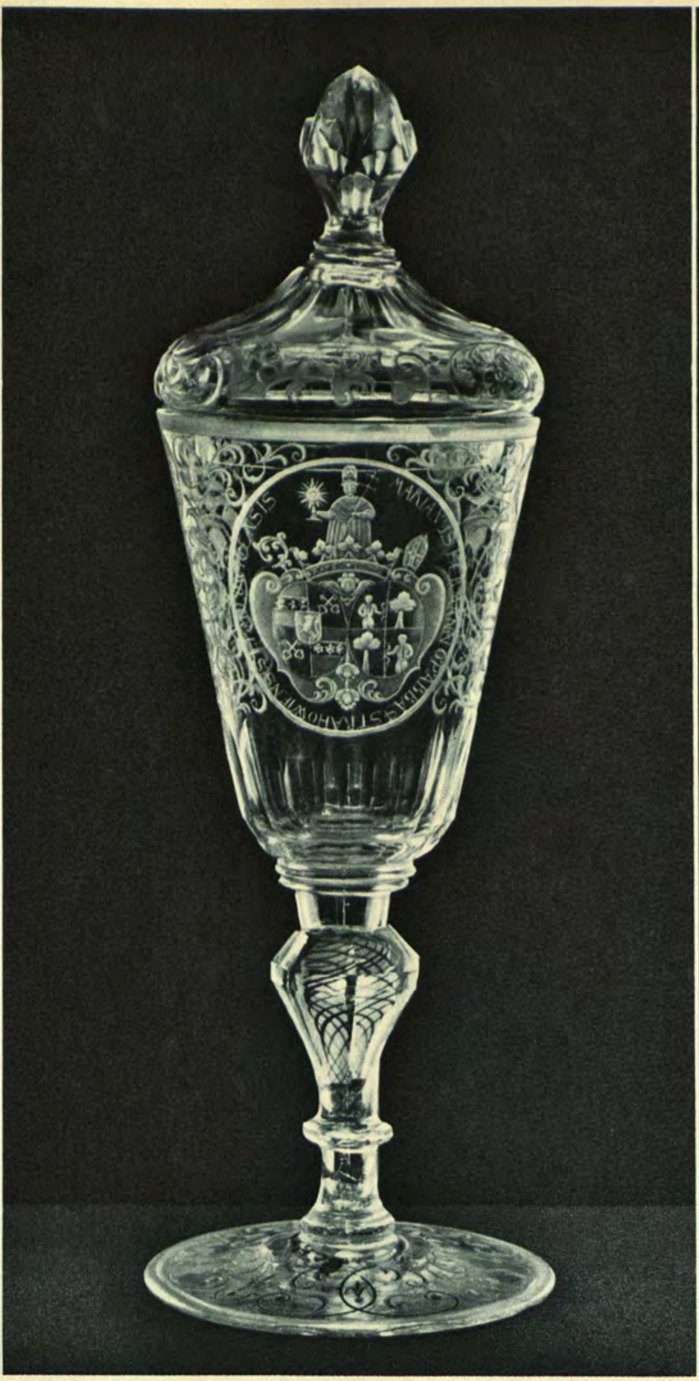


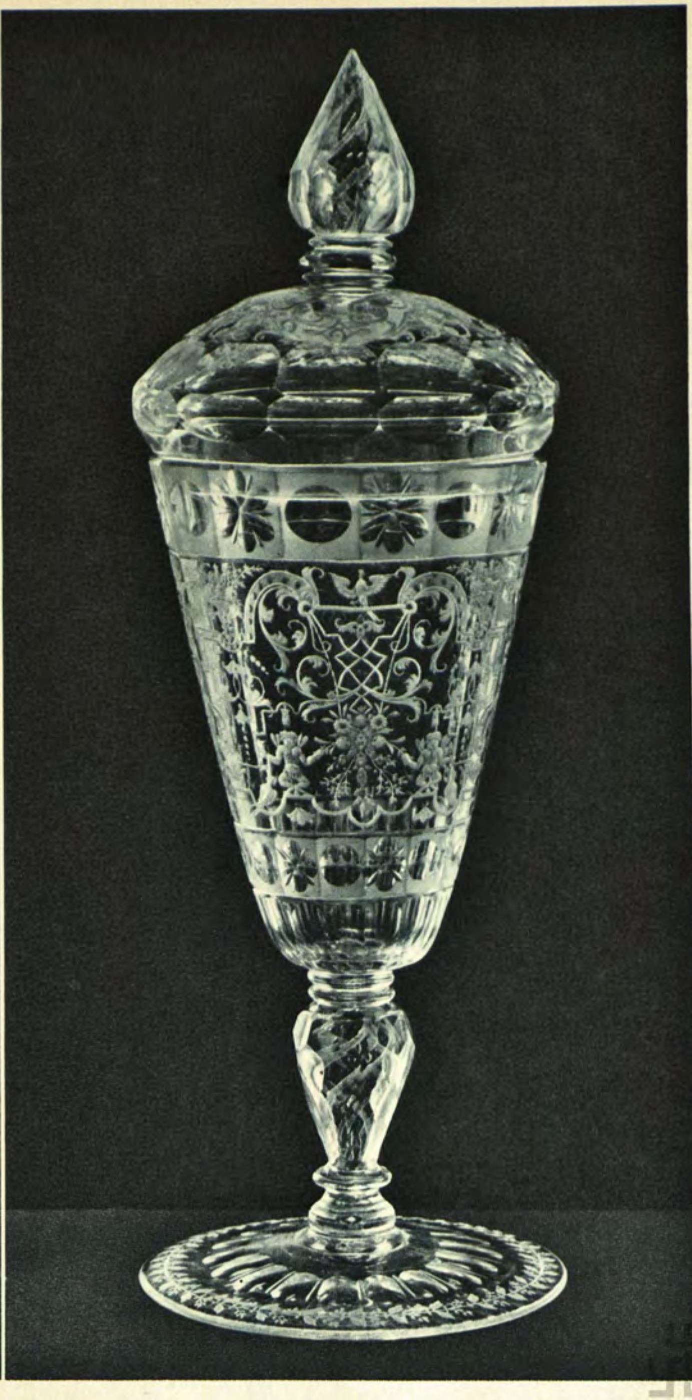




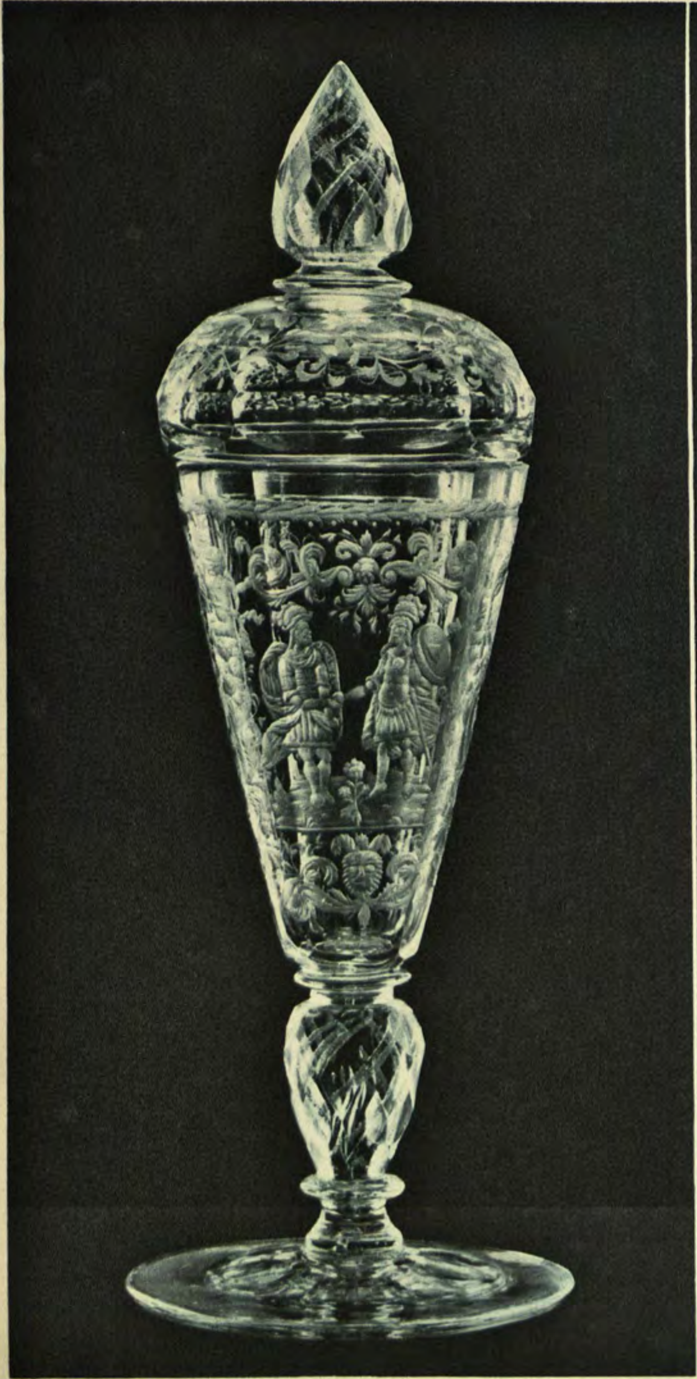
177. Baroque Vessel with Lid. Engraved, Bohemia, First Quarter of 18th Century. (PACM). Photo: J. Brok, Prague. 178. Baroque Goblet, with Engraved Leaf Ornaments and Birds, A Ruby Spiral is Melted into the Stem. Bohemia, Beg. of 18th Century. (PACM). Photo: J. Brok, Prague. 179. Baroque Vessel with Lid, Cut and Engraved, with a Ruby and Avanturin Spiral in the Stem. Bohemia, First Quarter of 18th Century. (PACM). Photo: J. Brok, Prague.

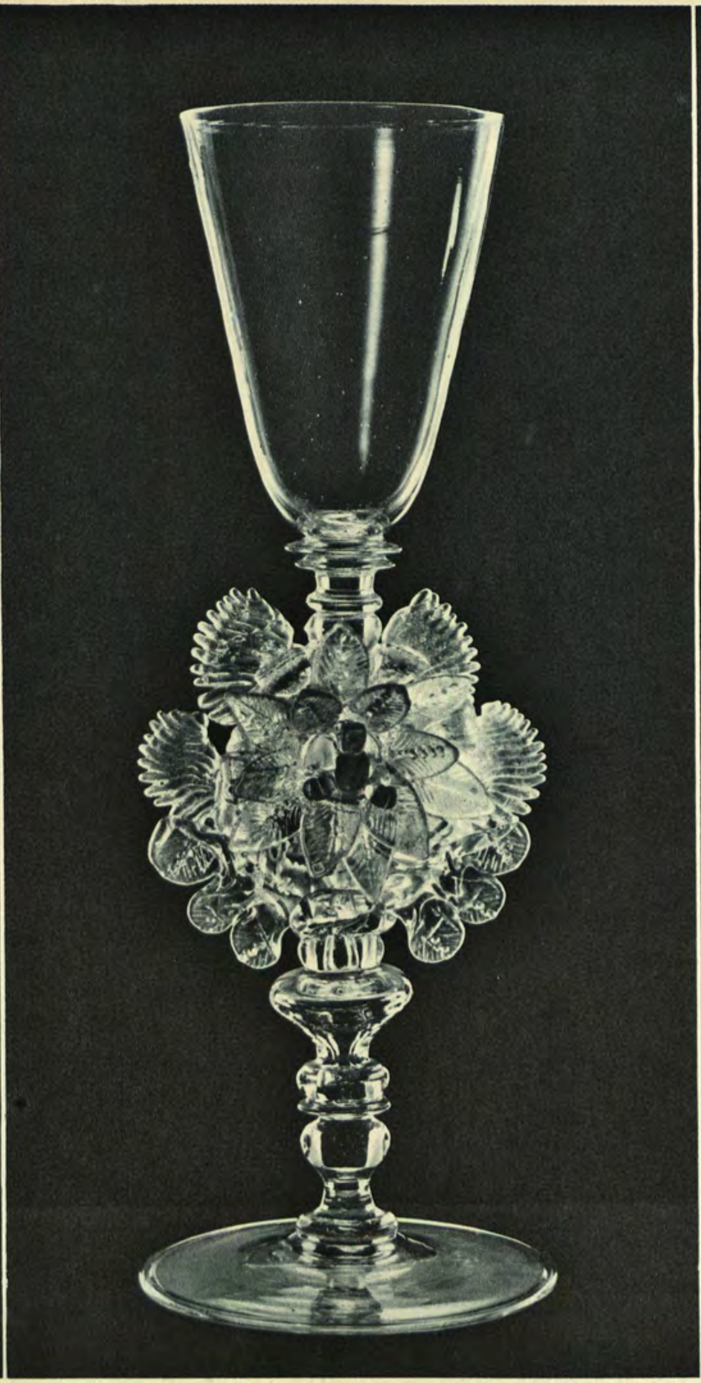


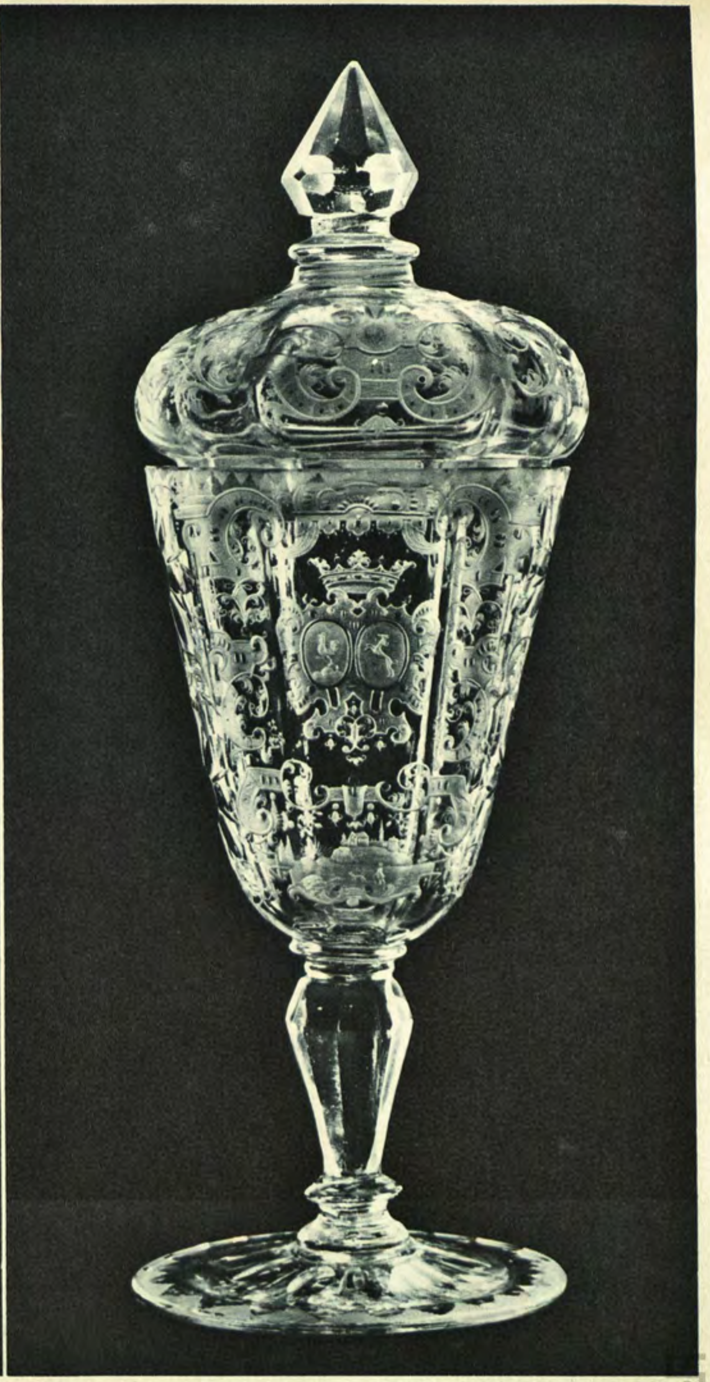




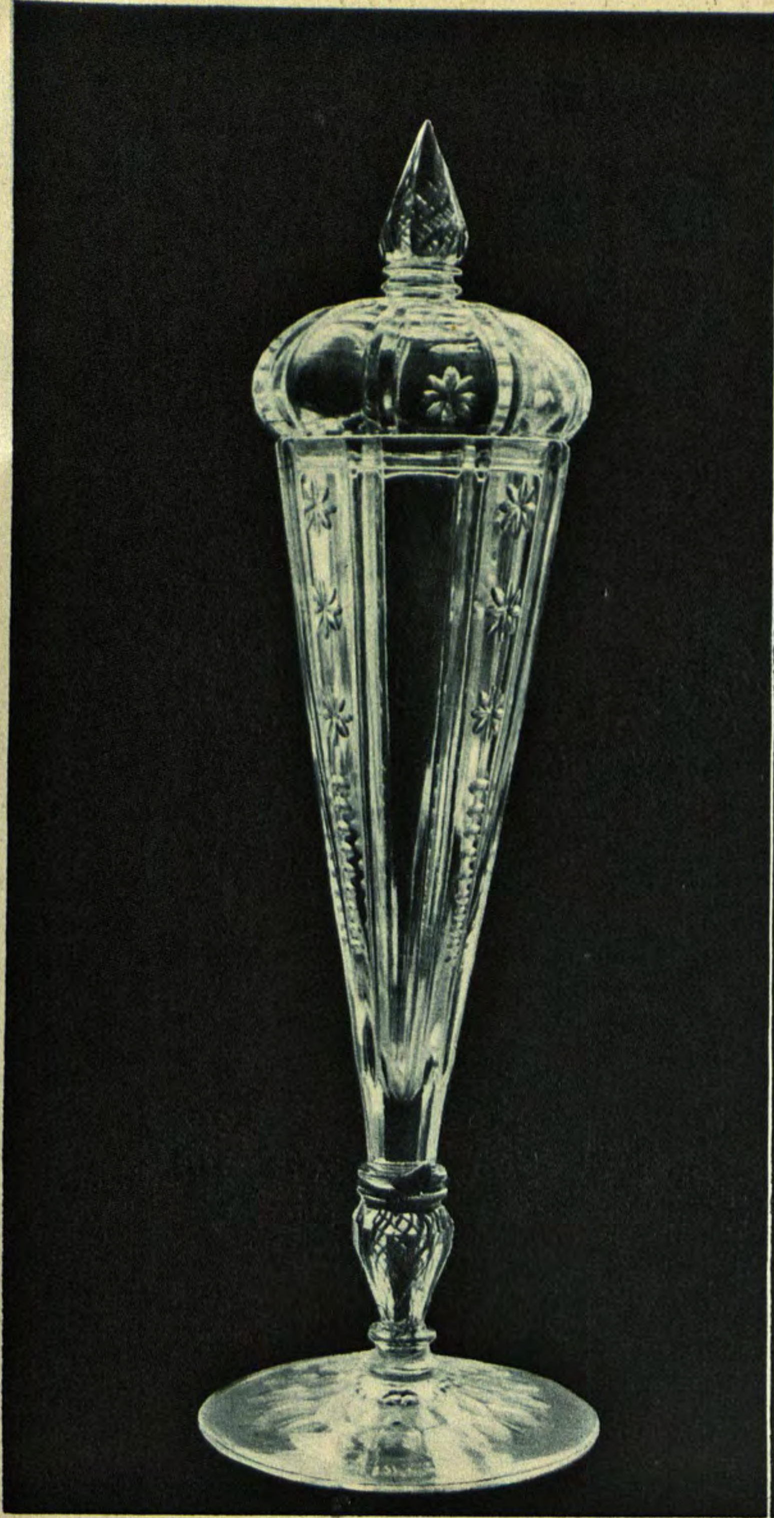
180. *Baroque Vessel with Engraved Foliage and Thread Decorations, Festoons of Fruits etc. Bohemia, About 1720. (PACM) Photo: J. Brok, Prague.* 181. *Baroque Vessel with Engraved Coat-of-Arms of the Abbot of Strahov (Prague) Marianus Hermann. Bohemia. (PACM) Photo: J. Brok, Prague.* 182. *Vessel with Lid with Engraved Thread and Foliage Decorations. Bohemia. About 1720. (PACM) Photo: J. Brok, Prague.*

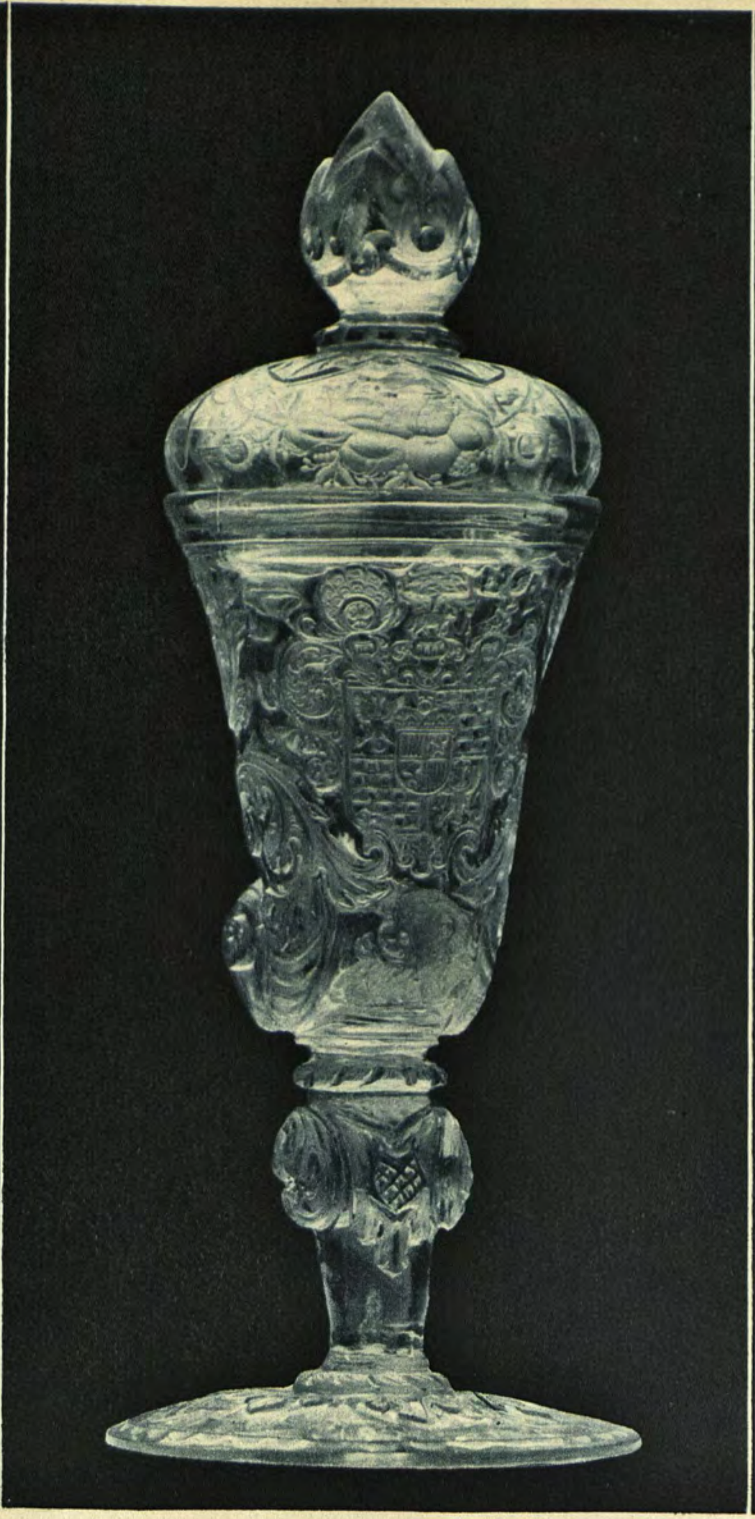


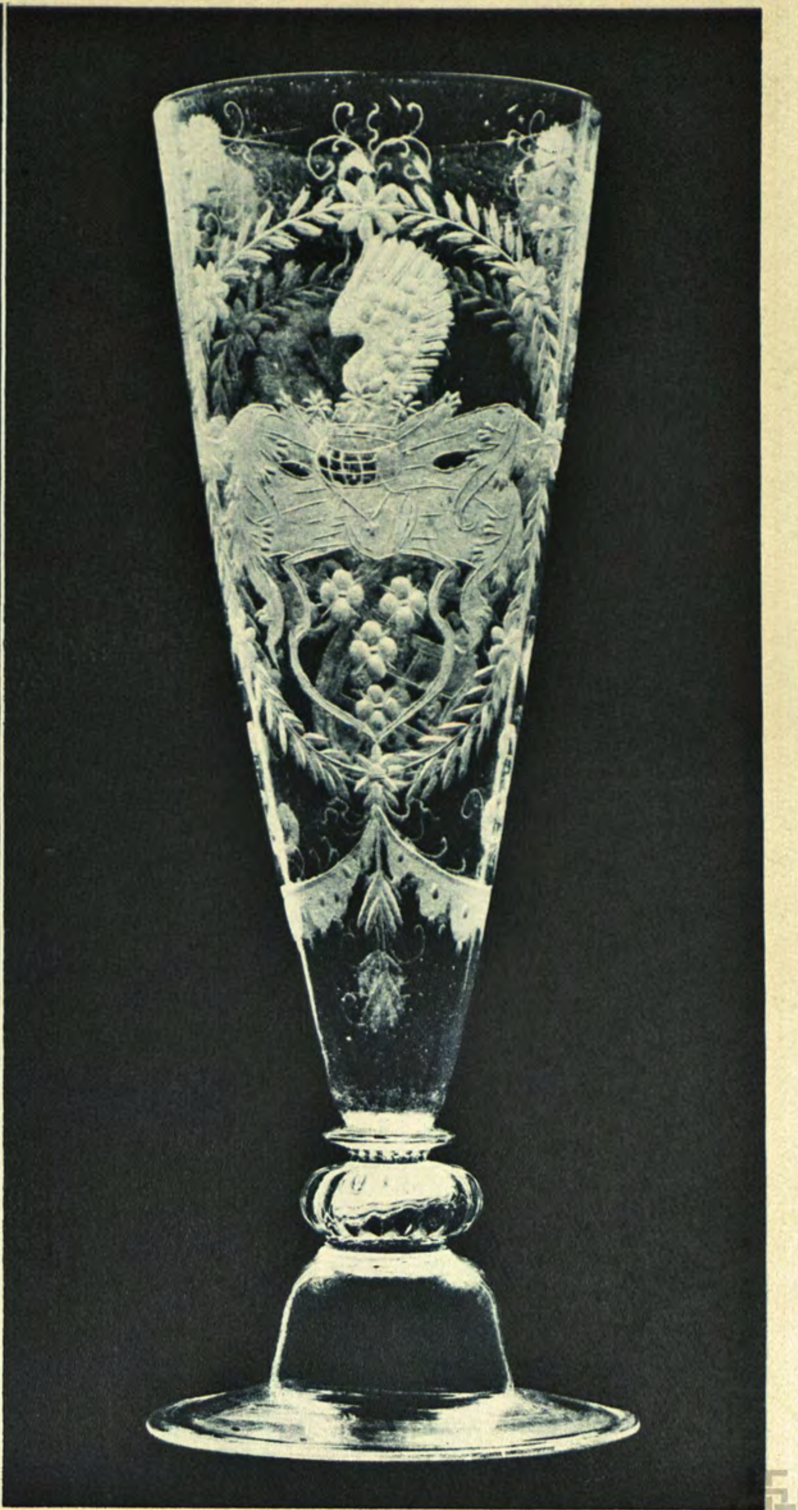




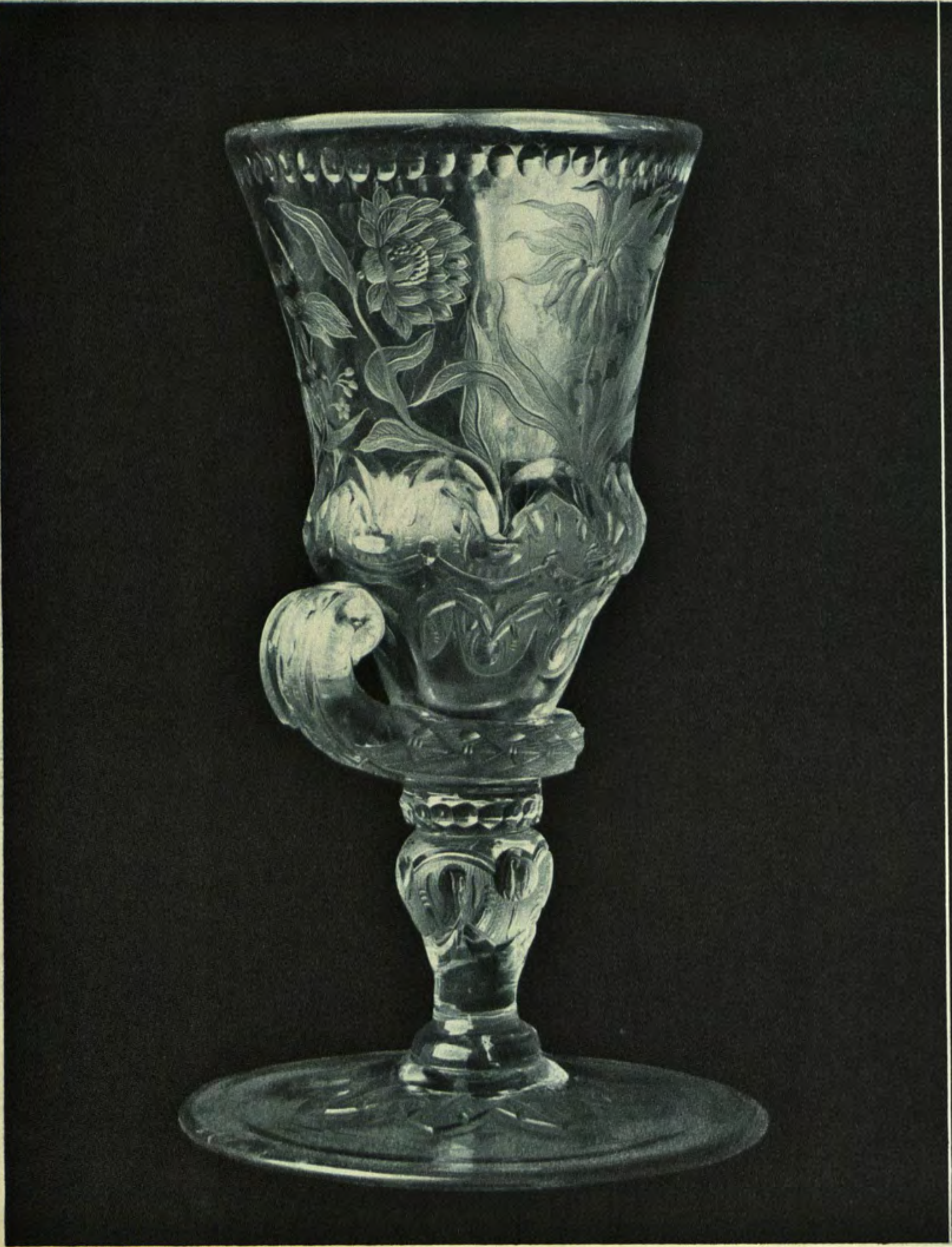
183. Engraved Baroque Vessel, Bohemia, Beg. of 18th Century. (PACM) Photo: J. Brok, Prague. 184. Decorated Venetian Vessel with a Rose Stem. Bohemia, End of 17th Cent. (PACM) Photo: J. Brok, Prague. 185. Vessel with Flacon Lid, Baroque Cut, with Coat-of-Arms. Bohemia, About 1735. (PACM) Photo: J. Brok, Prague.



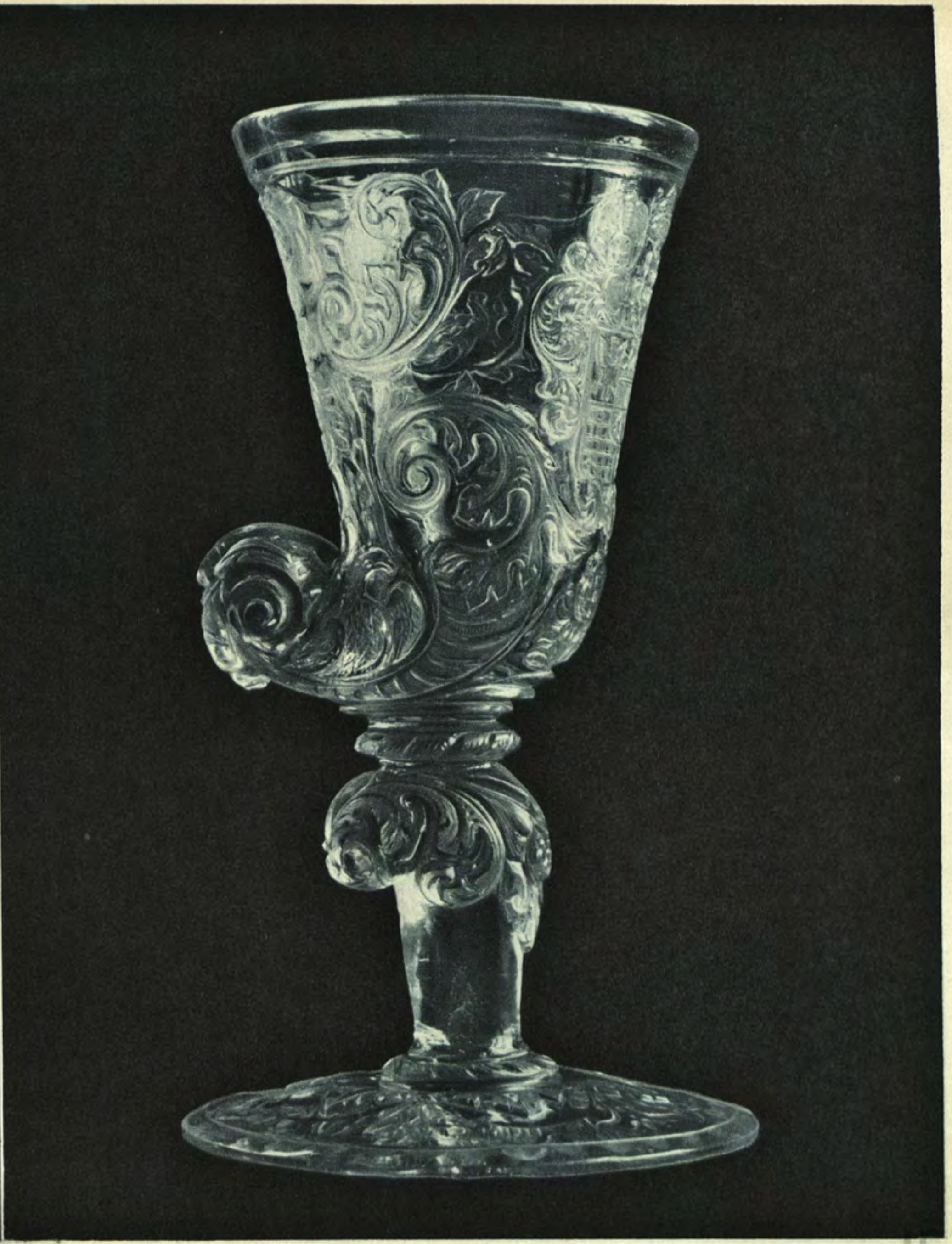




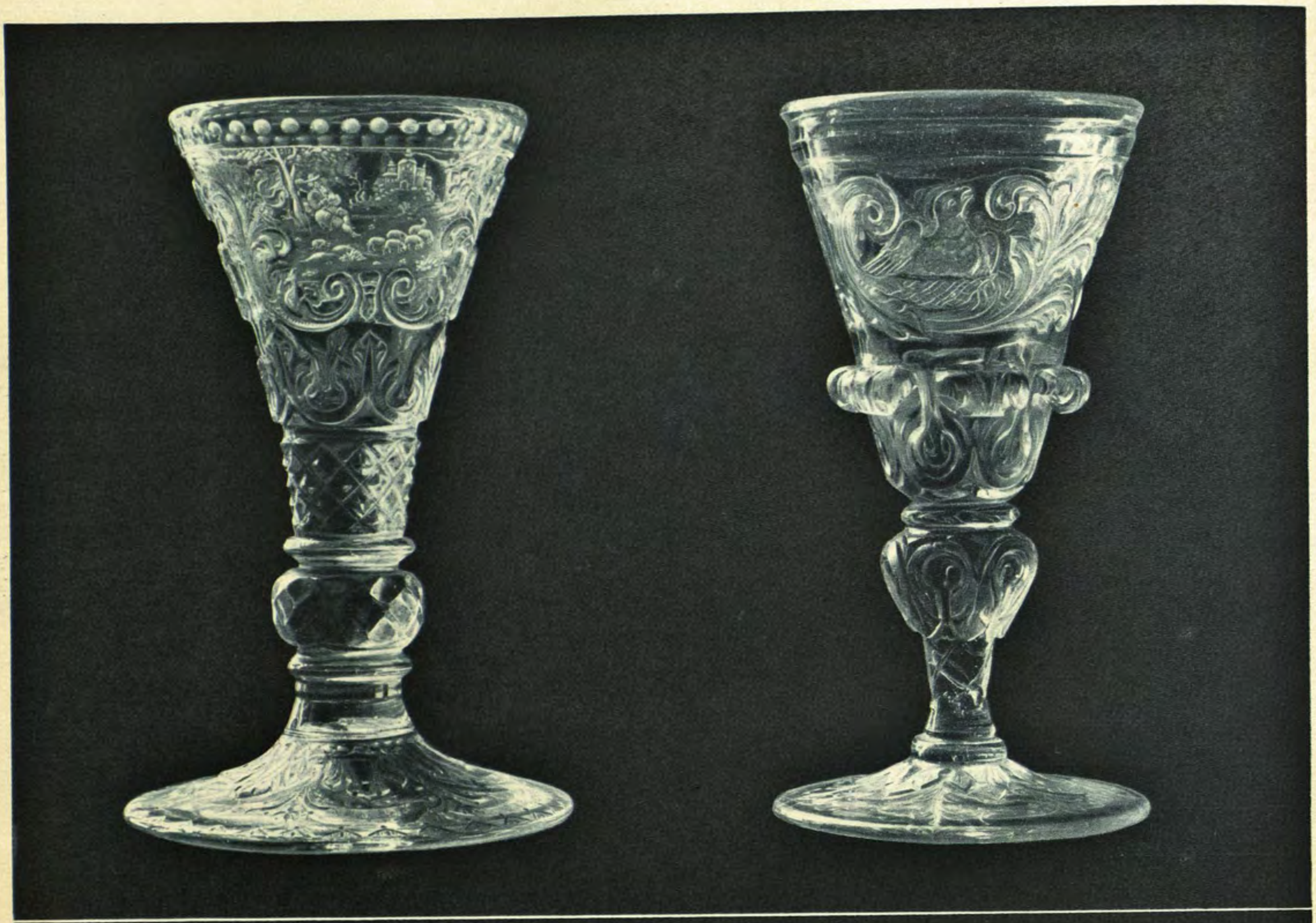
186. Cut, Bohemian Drinking-Cup, About 1700. (PACM) 187. Cut, Silesian Goblet in the Shape of the Horn of Plenty, with the Coat-of-Arms of the Schaffgotsch Family, Below a Lion. Hirschberg (now Jelenia Góra). End of 17th Cent. (PACM) Photo: ÚLUV — J. Otto. 188. Beaker with a Bell-Shaped Stem, Engraved with the Coat-of-Arms of the Haintz-Schönau Family. Bohemia, 17th Cent.

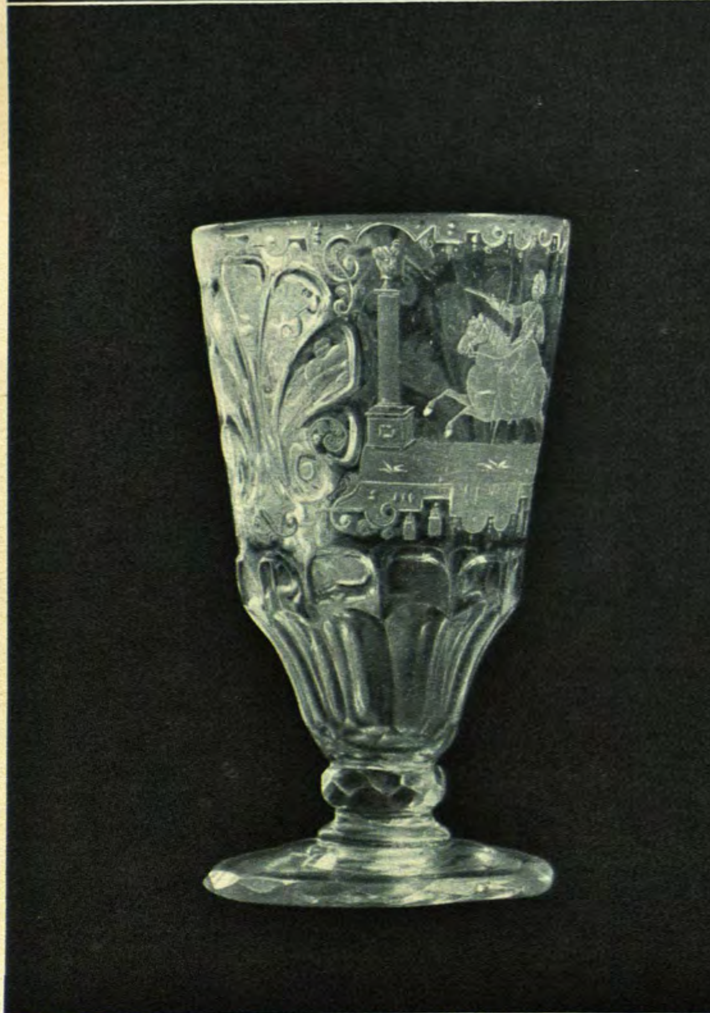


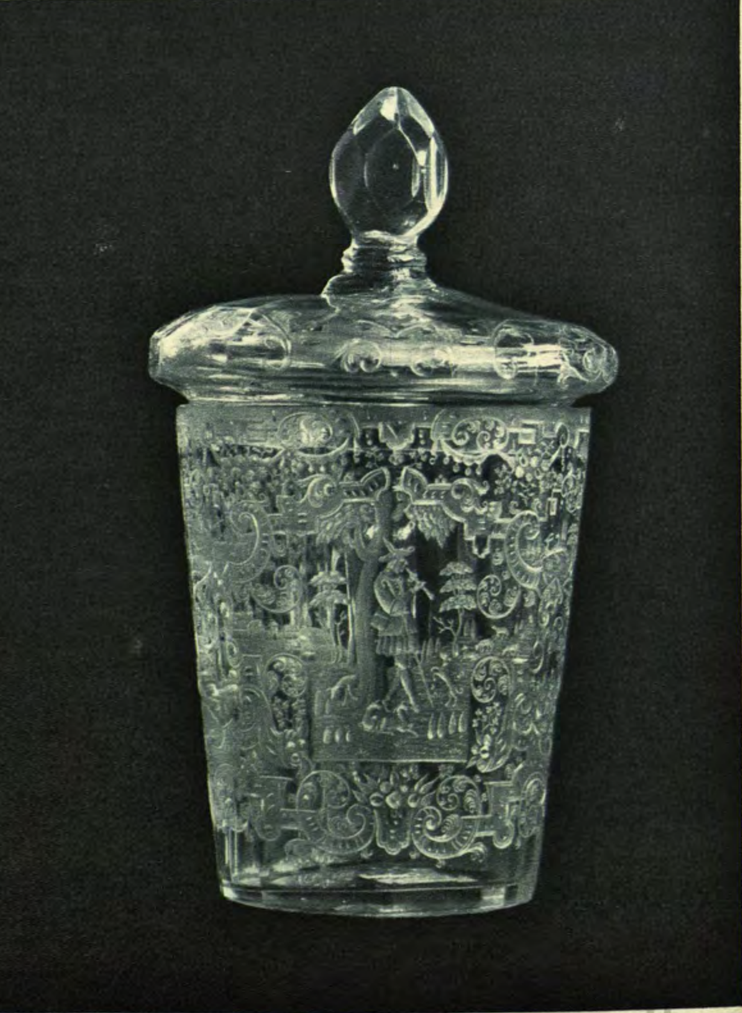
189. Goblet with Deep Intaglio Decorations in the Rock-Crystal Manner. Silesia, Schaffgotsch Glass-House, About 1700. (PACM)



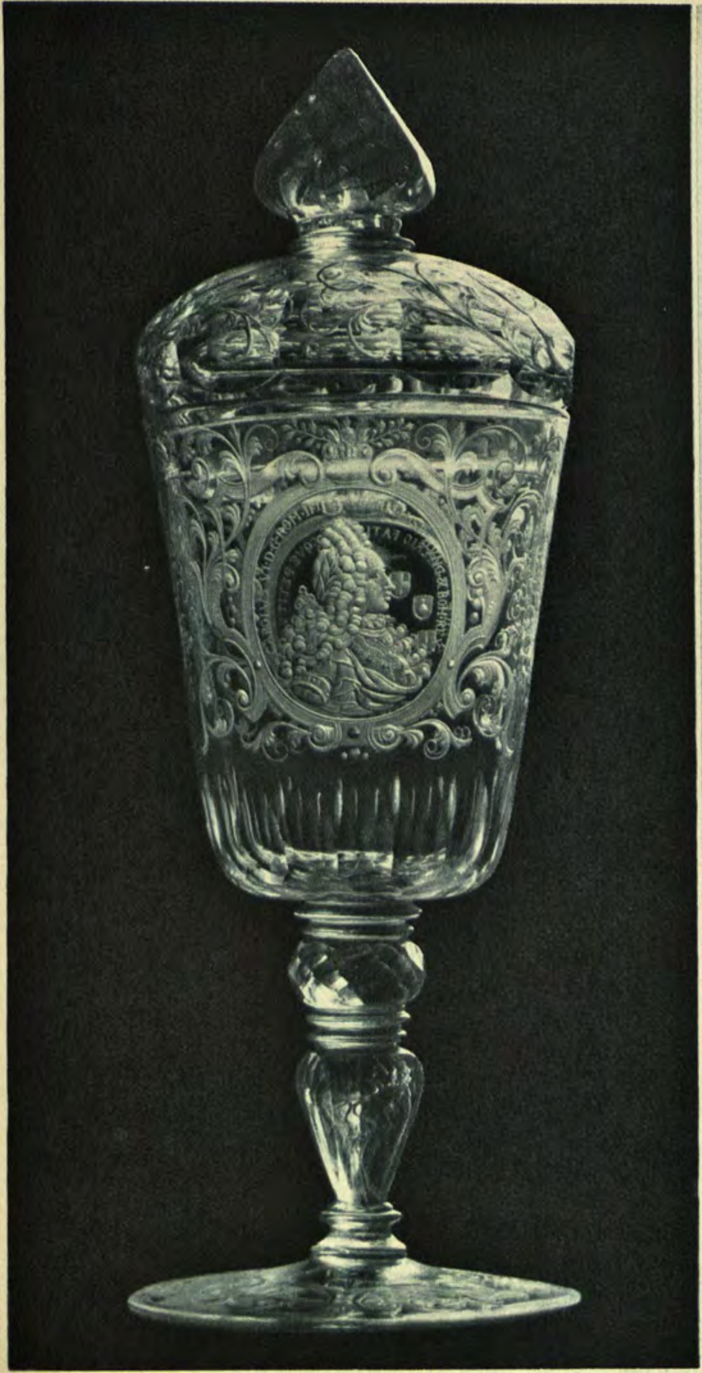
190. A Similar Goblet with the Coat-of-Arms of the Schaffgotsch Family. Silesia, Hirschberg Valley, End of 17th Cent. (PACM)

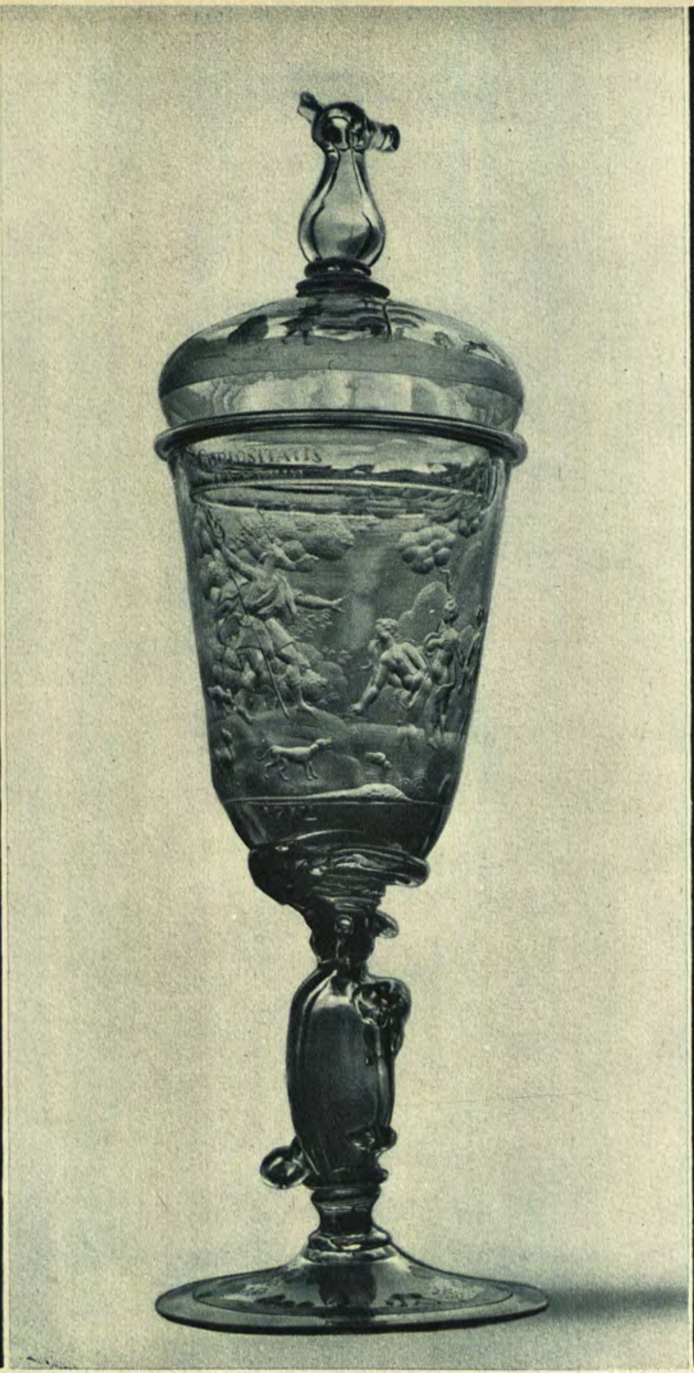


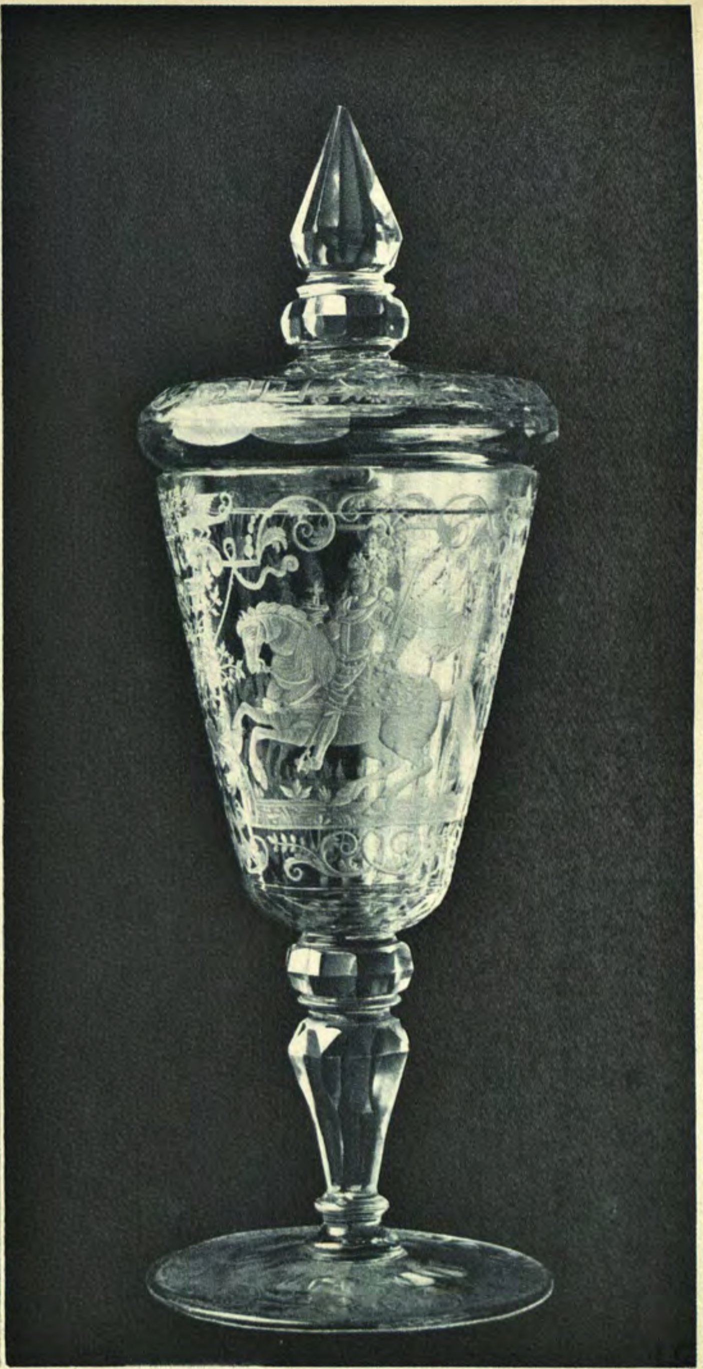




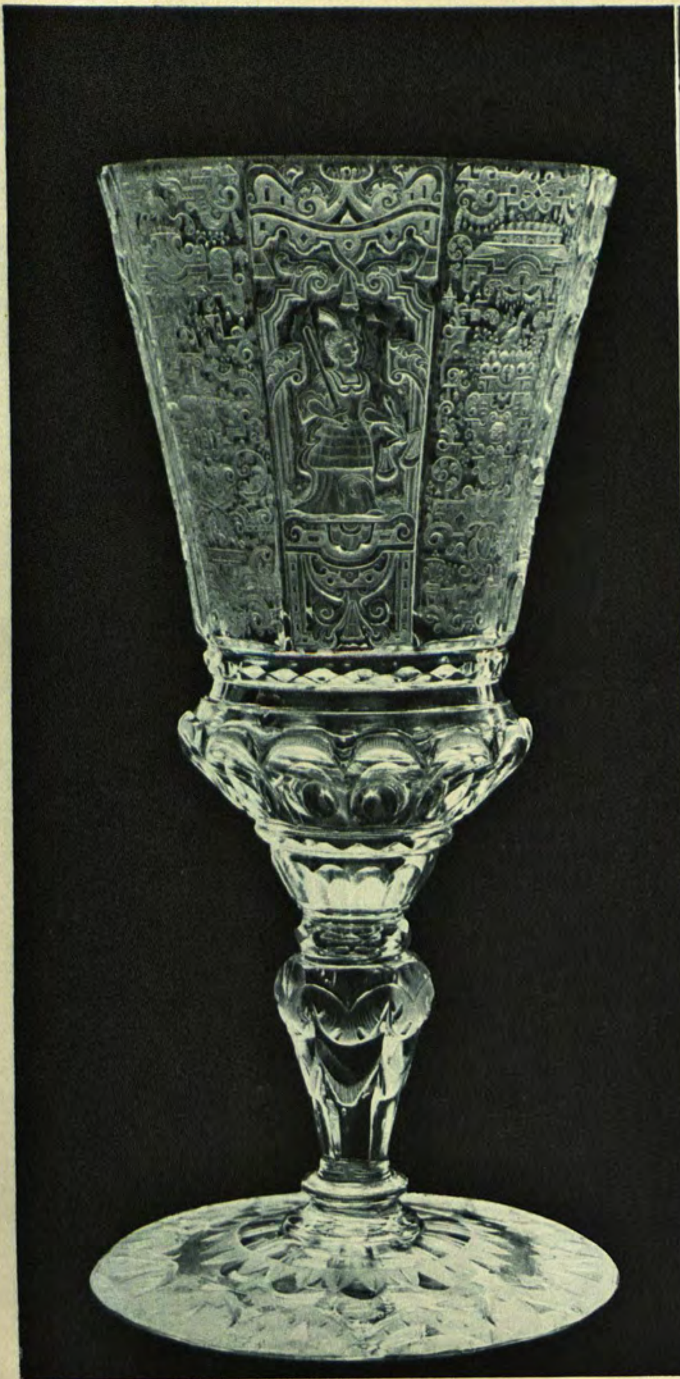
191. Silesian Bas-Relief Goblets from the End of the 17th Cent. (PACM) 192. Silesian Cut-Glass Beaker, First Half of 18th Century. (PACM) 193. Bohemian Glass with Lid, Engraved (Shepherd Scenes). Middle of 18th Cent. (PACM)

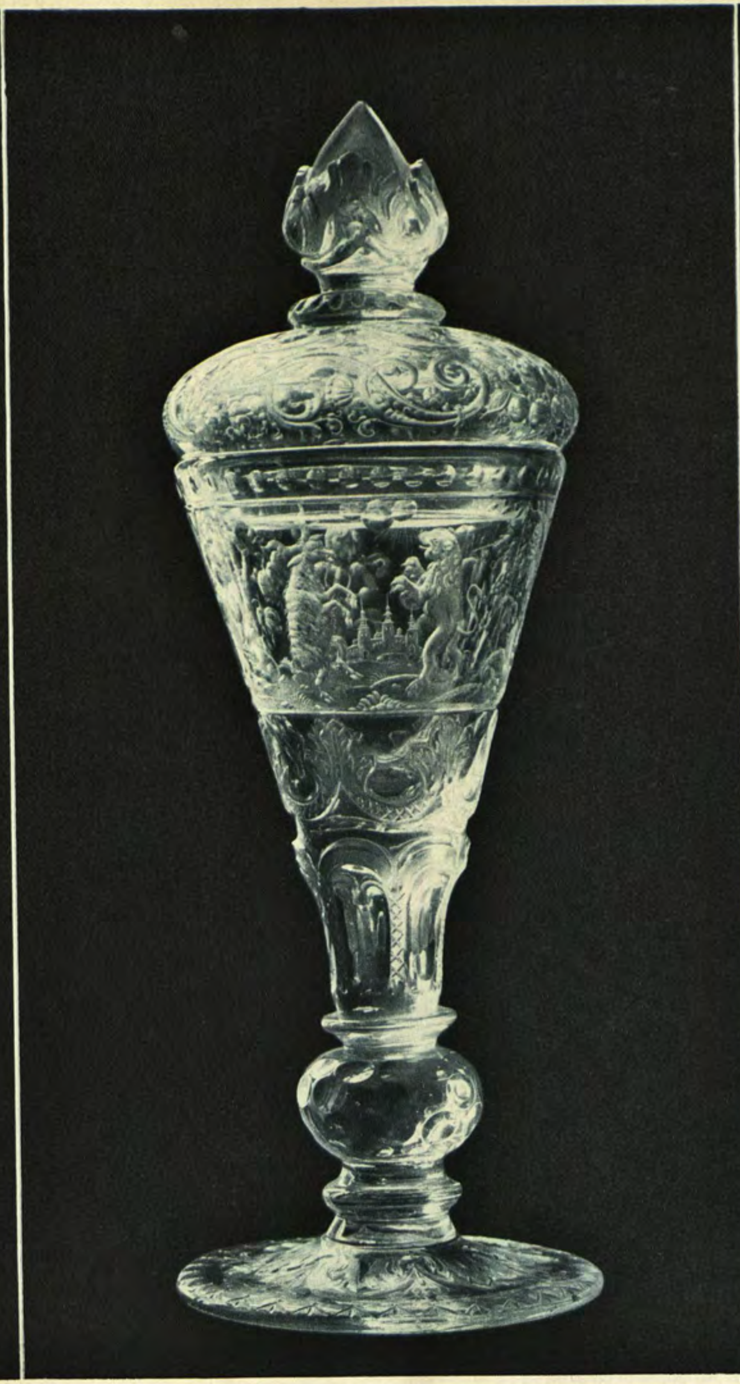


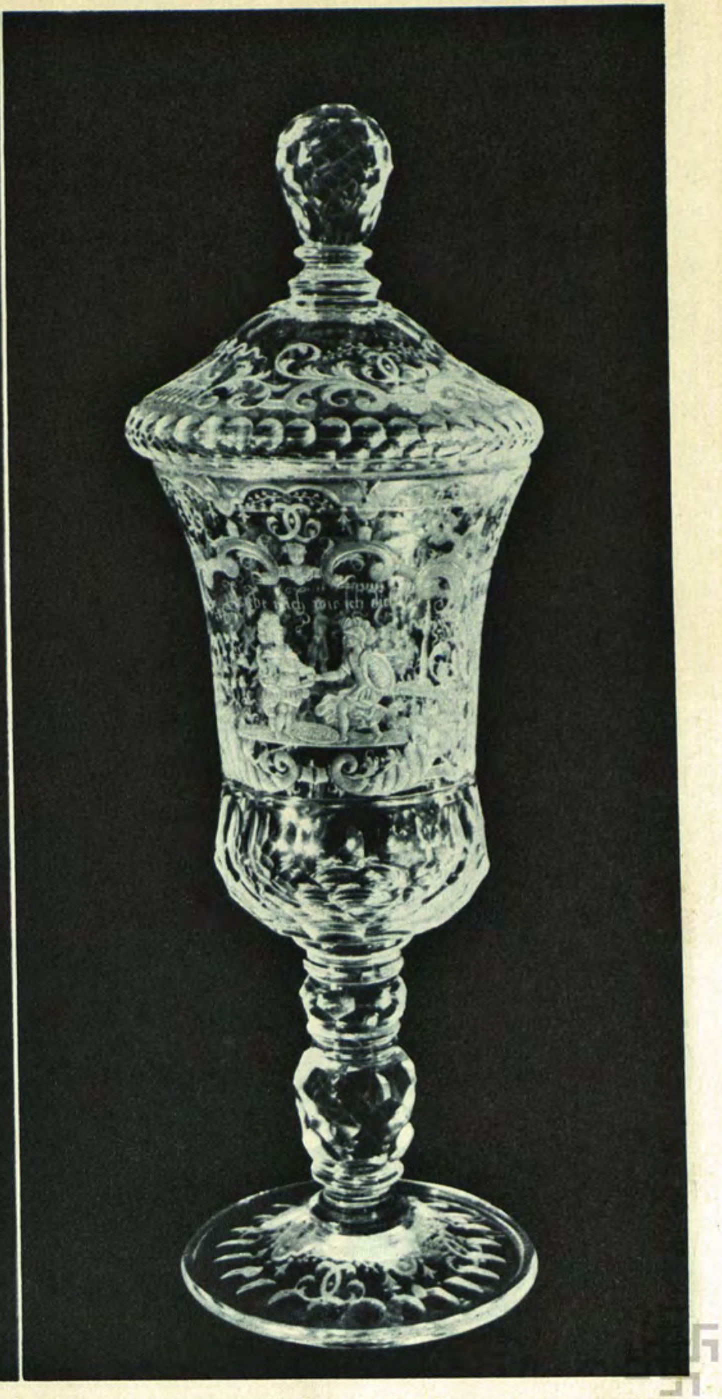




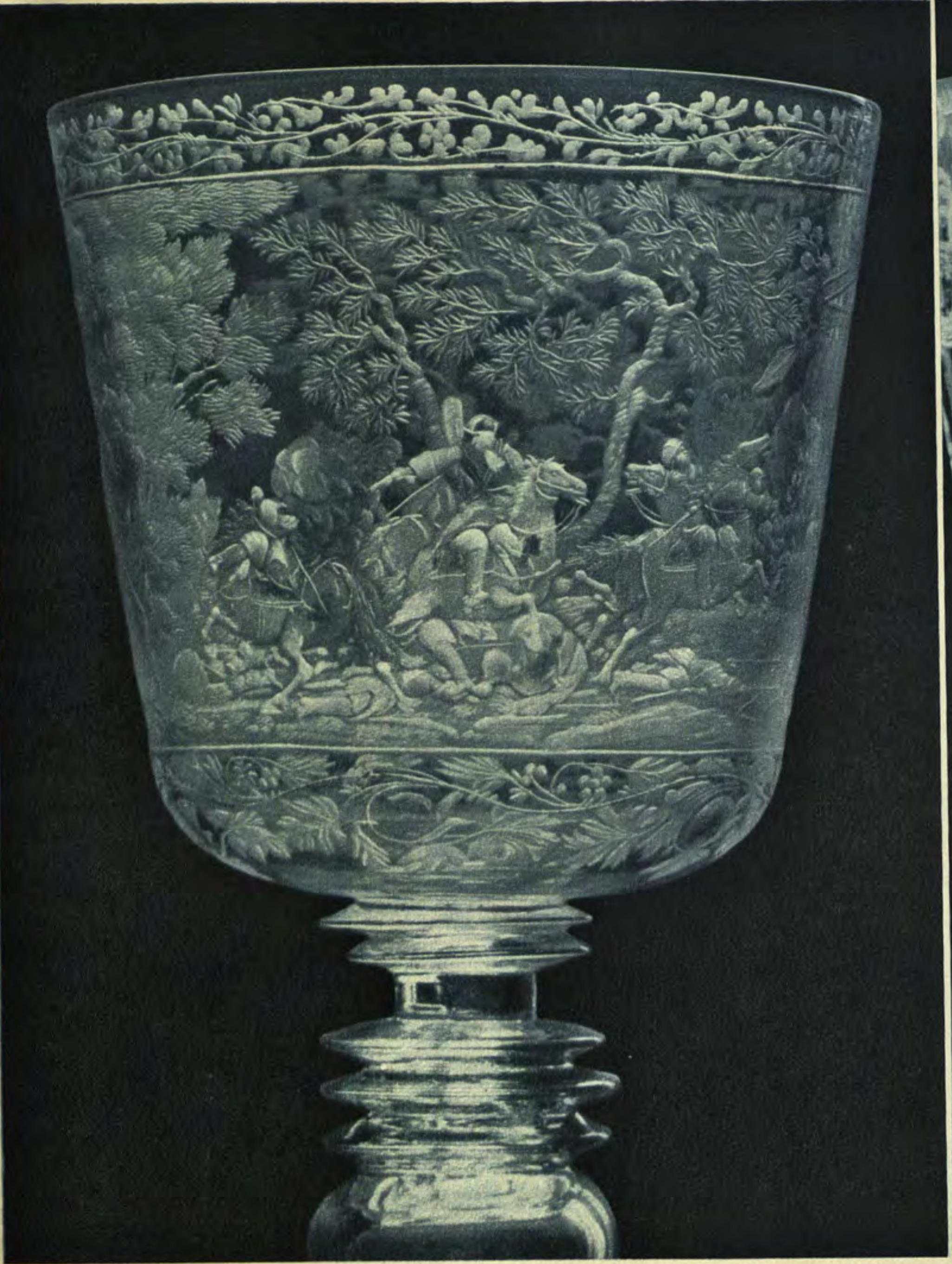
194. Engraved, Cut-Glass Goblet with the Portrait of Emperor Charles VI and the Coat-of-Arms of the Grand Electors. Bohemia, 1711. (PACM) 195. Engraved, Cut-Glass Goblet with Stem in Shape of a Bear. The Engraving Represents Diana with Acteon, 1712. Germany. (PACM) 196. Engraved, Cut-Glass Goblet with the Portrait of Emperor Leopold I. First Half of 18th Century. (PACM)



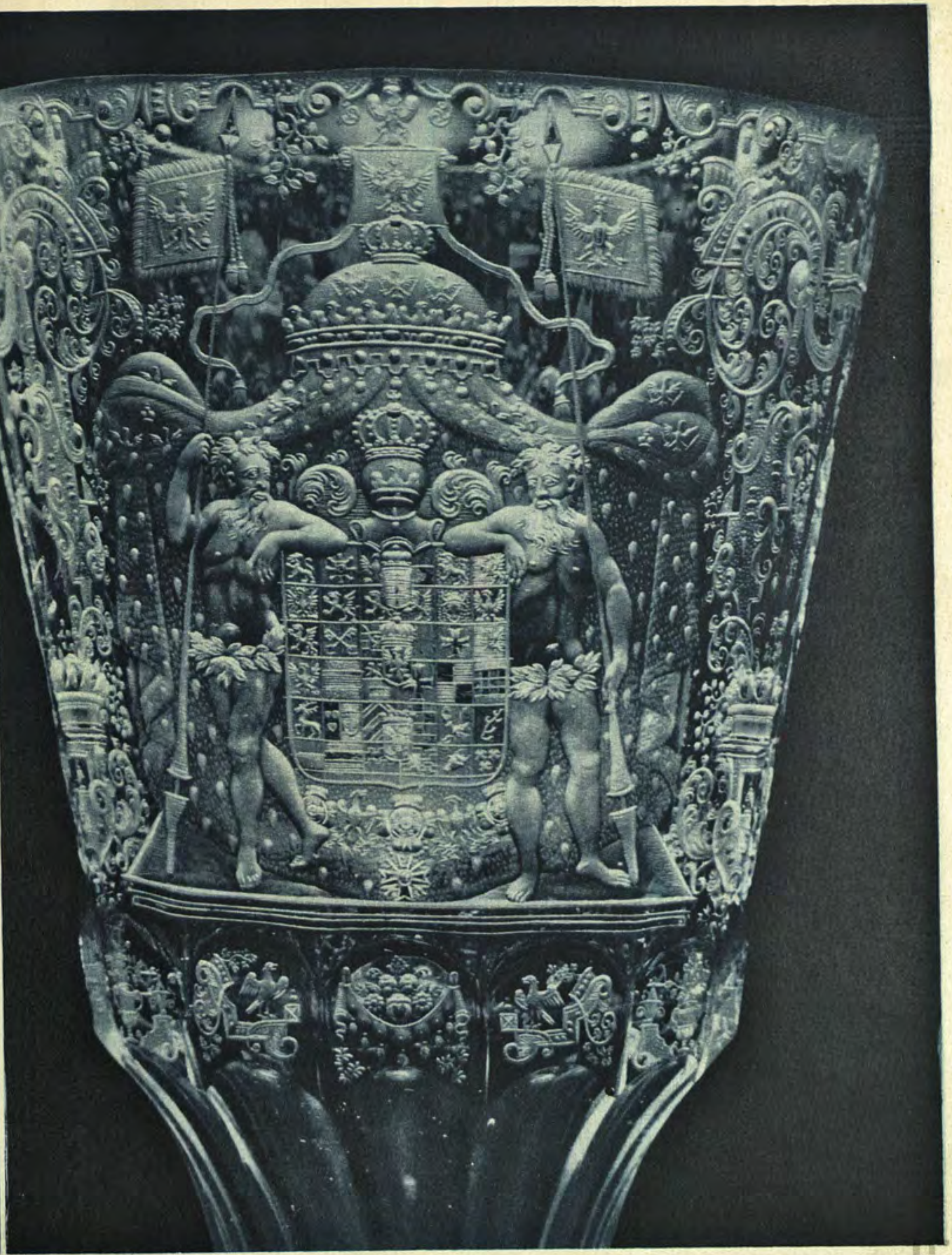




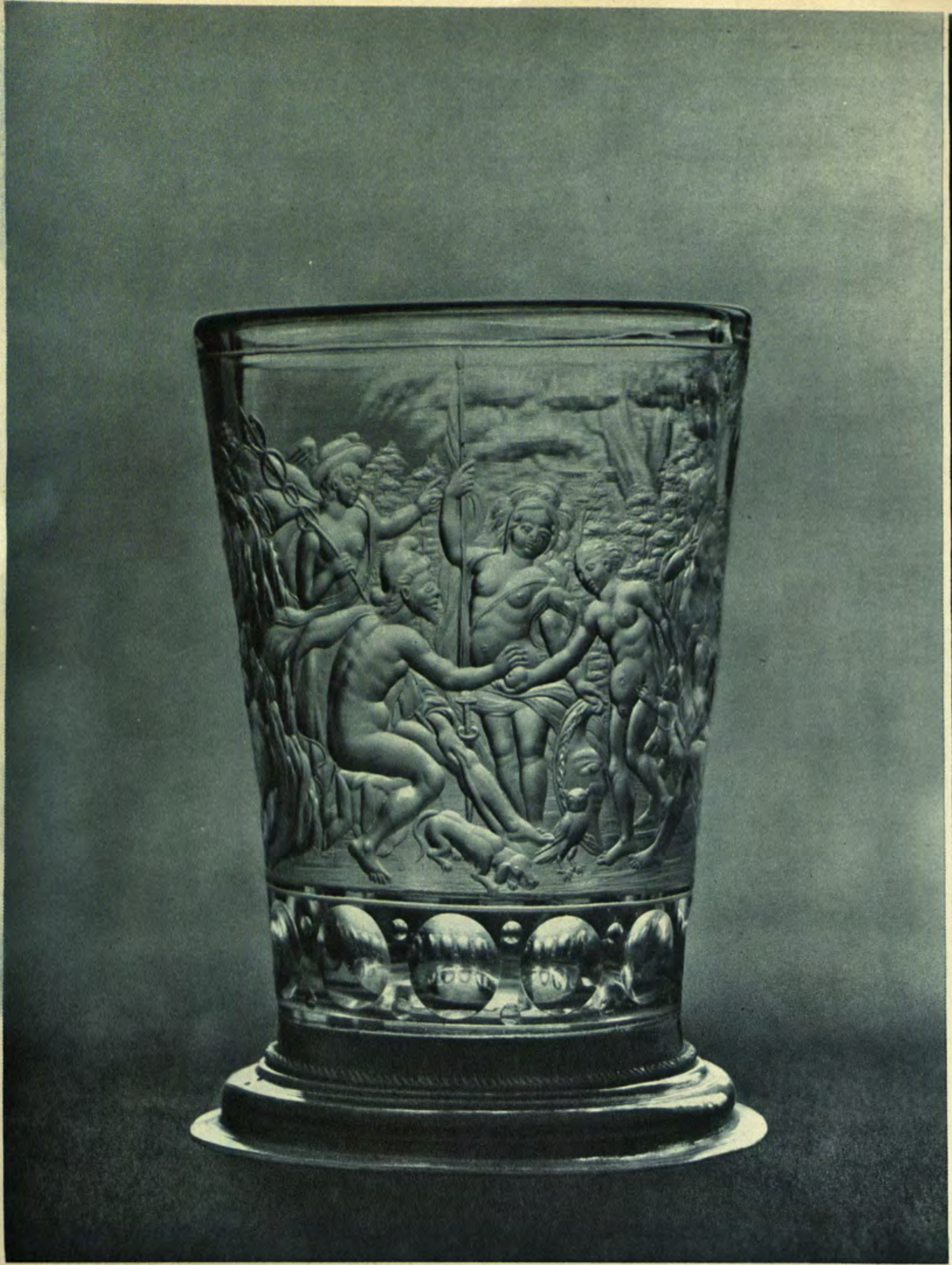
197. *Richly Engraved, Cut-Glass Goblet from Silesia. First Half of 18th Cent.* (PACM) 198. *Engraved Cut-Glass Goblet, Dance of the Beasts. Silesia. 18th Cent.* (PACM) 199. *Baroque Goblet, Cut-Glass, Richly Engraved.* (PACM)



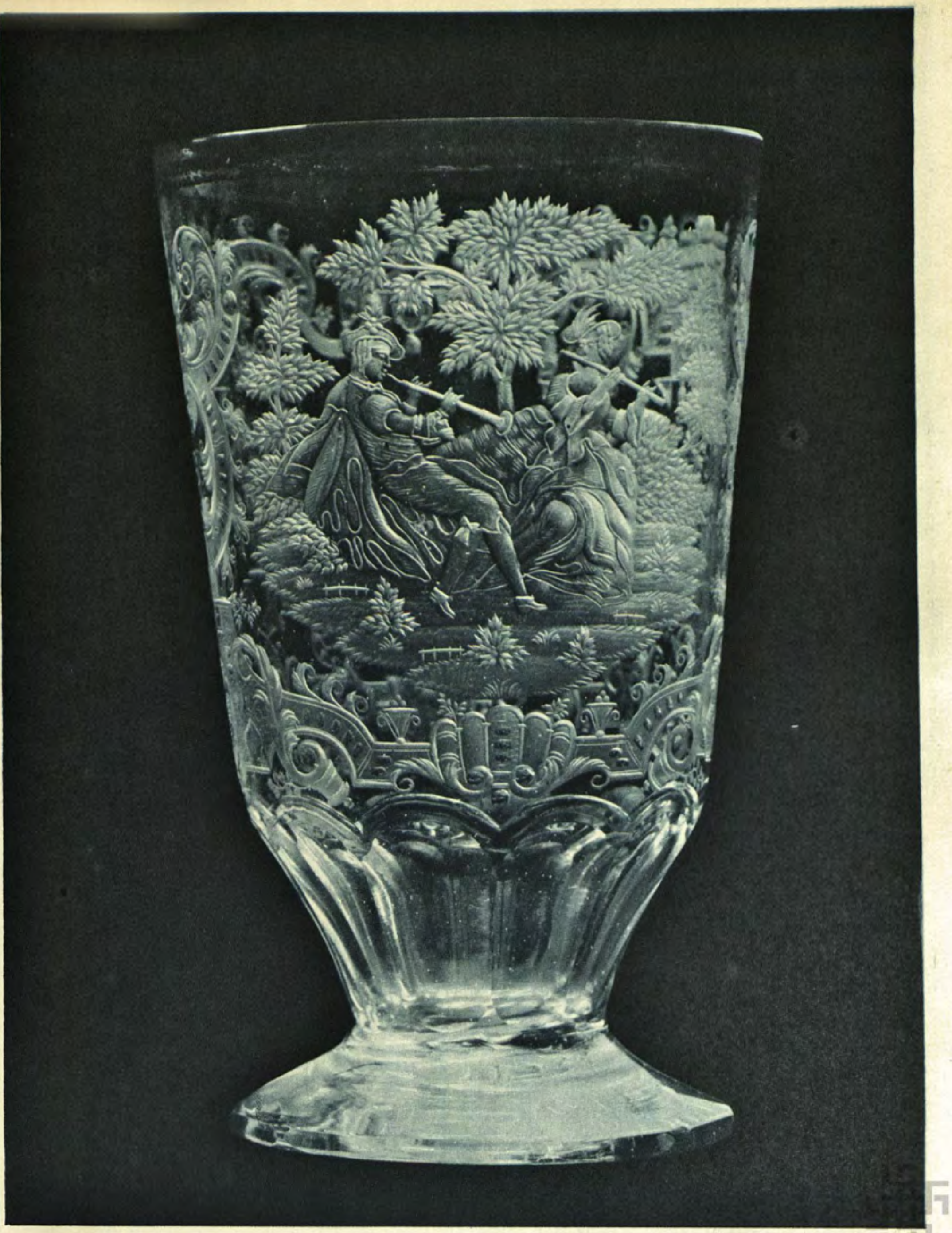
200. Detail of the Engraving on the Nuremberg Goblet "Cavalry Battle" H. W. Schmidt. 1690. (PACM)



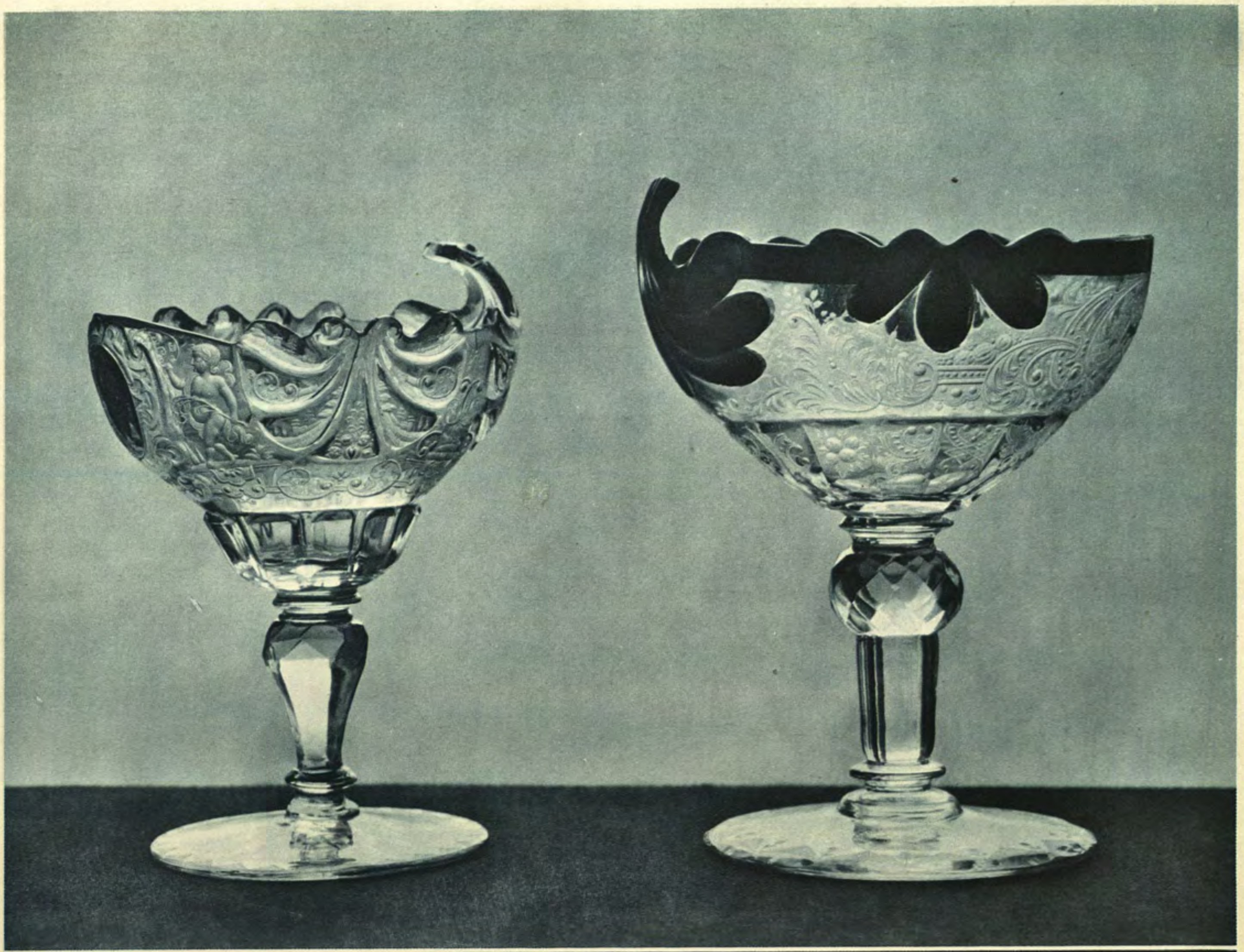
201. Detail of the Baroque Engraving of a Coat-of-Arms and an Allegory on a Goblet.

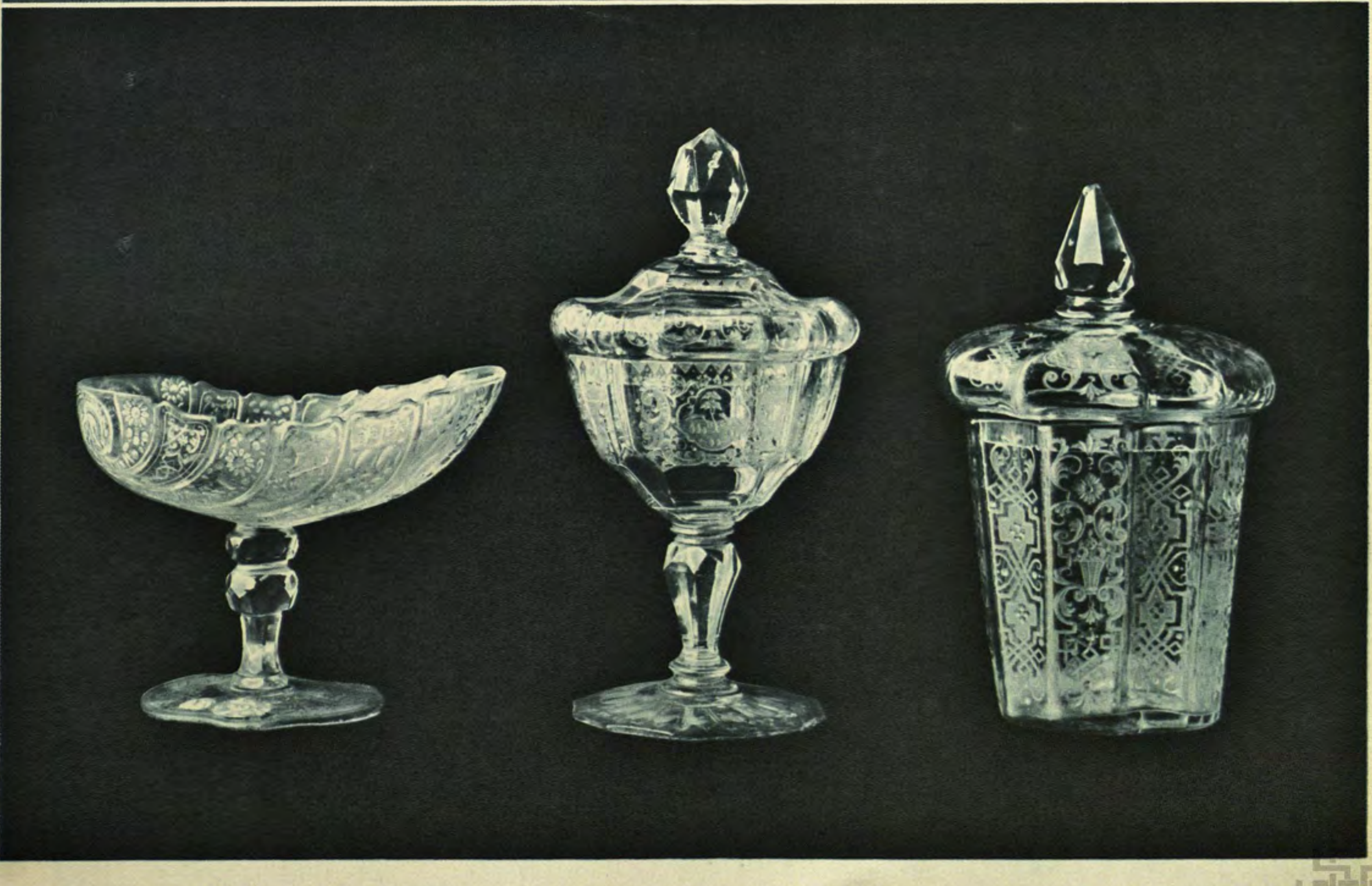


202. *Engraved, Cut-Glass, Bohemian Beaker. 18th Cent. (PACM)*

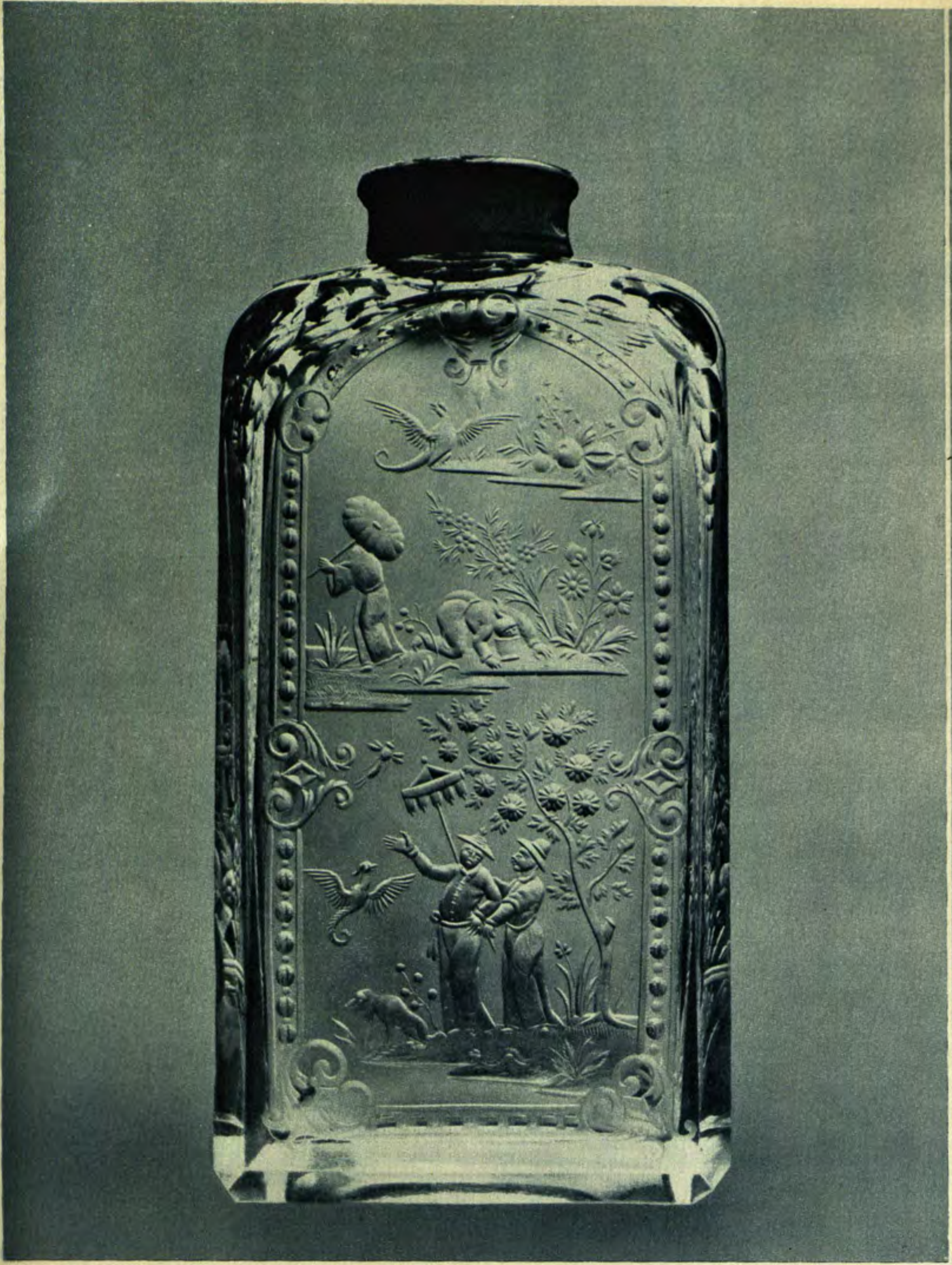


203. *Ch. G. Schneider, Silesia: Engraved, Cut-Glass Beaker. 1760. (PACM)*

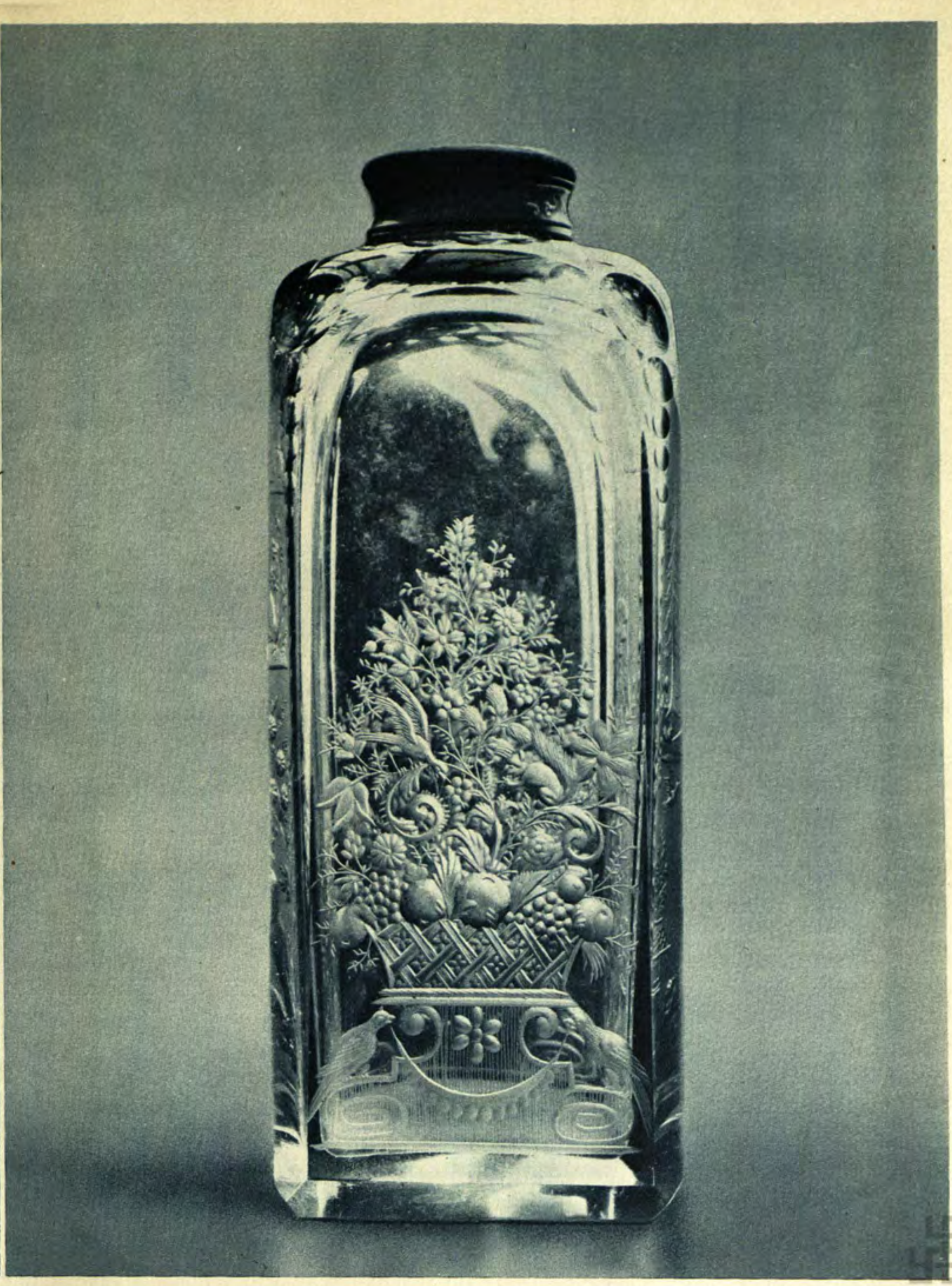




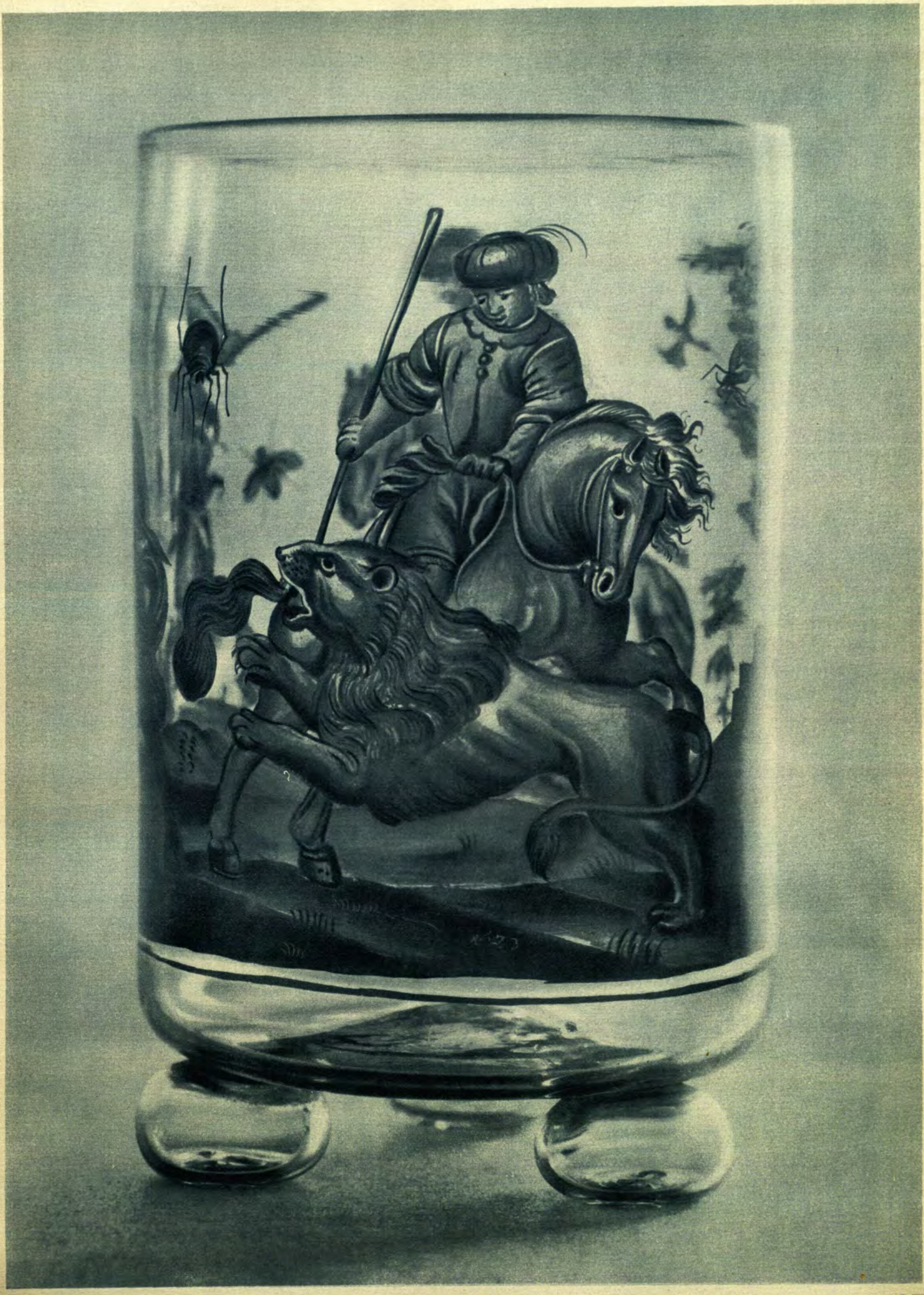
204. Engraved Glass with Plastic Decorations, Silesia, First Half of 18th Cent. (PACM) *205. Engraved and Cut Vessels of Crystal-Glass. 18th Cent. (PACM)*



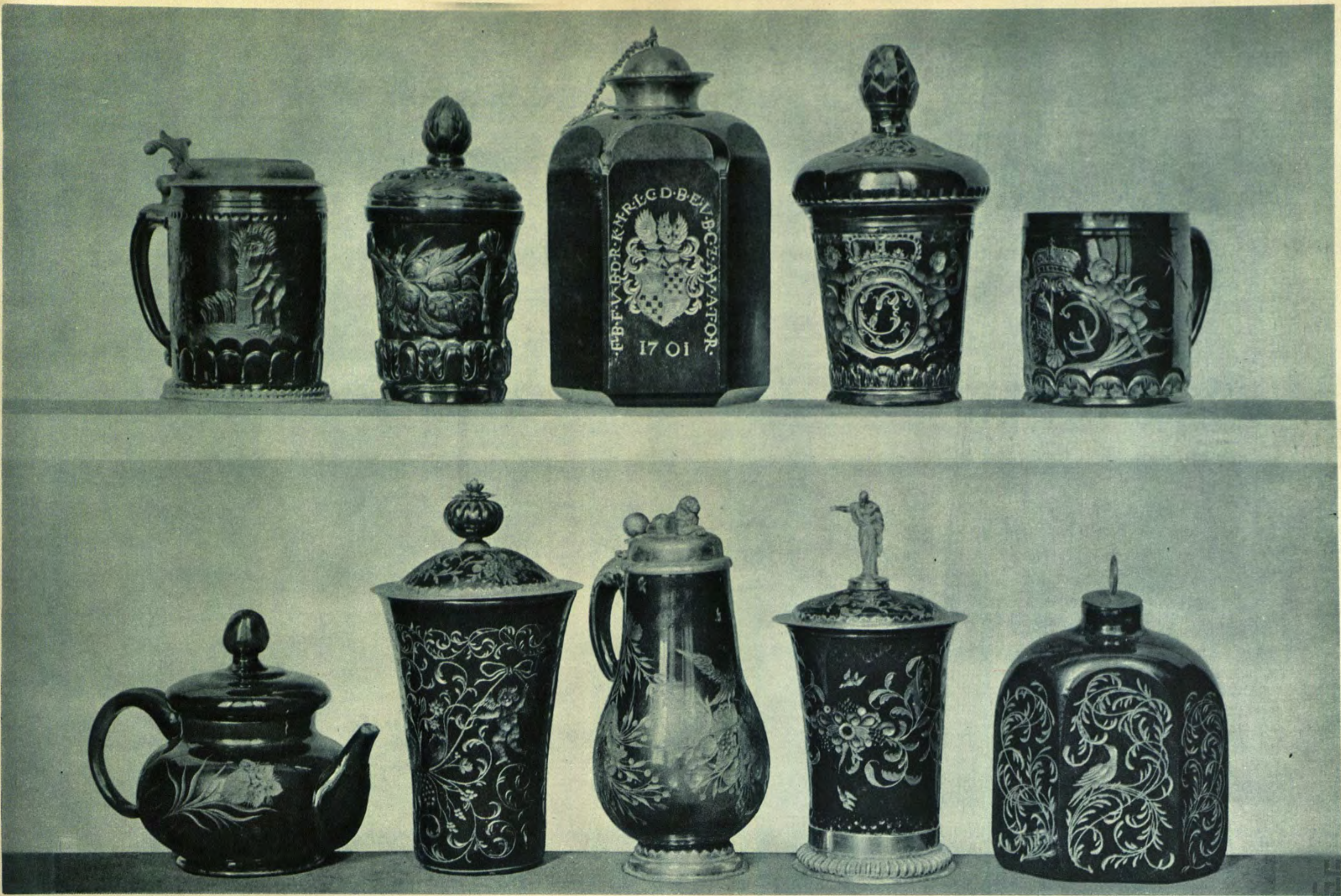
206. *Cut-Glass Flask with Chinese Decorations on a Dull Background. A. W. Mäuerl, Nuremberg. 17th Cent. (PACM)*



207. *Cut-Glass Flask with Flowers and Fruits. Dull Background.*

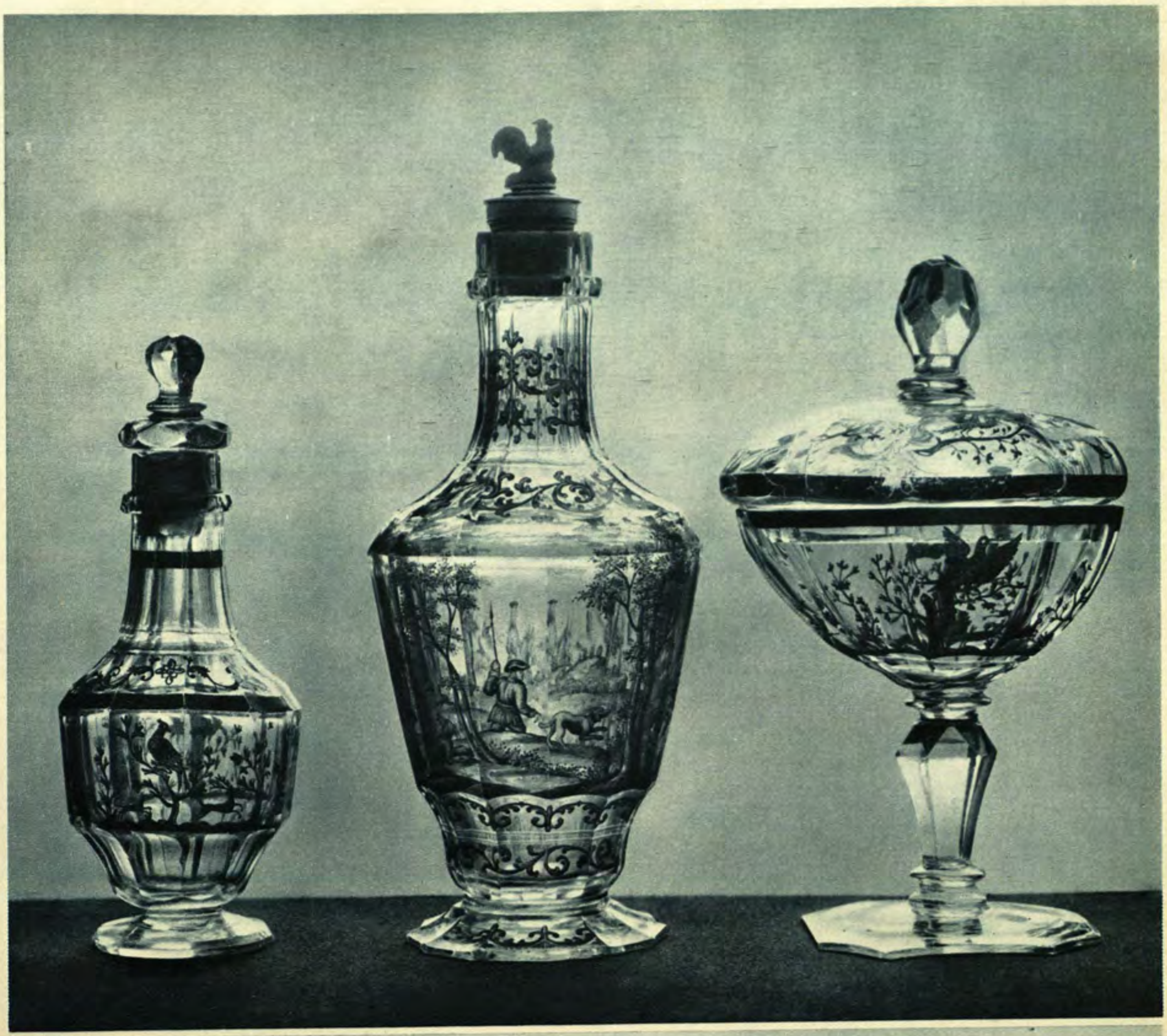


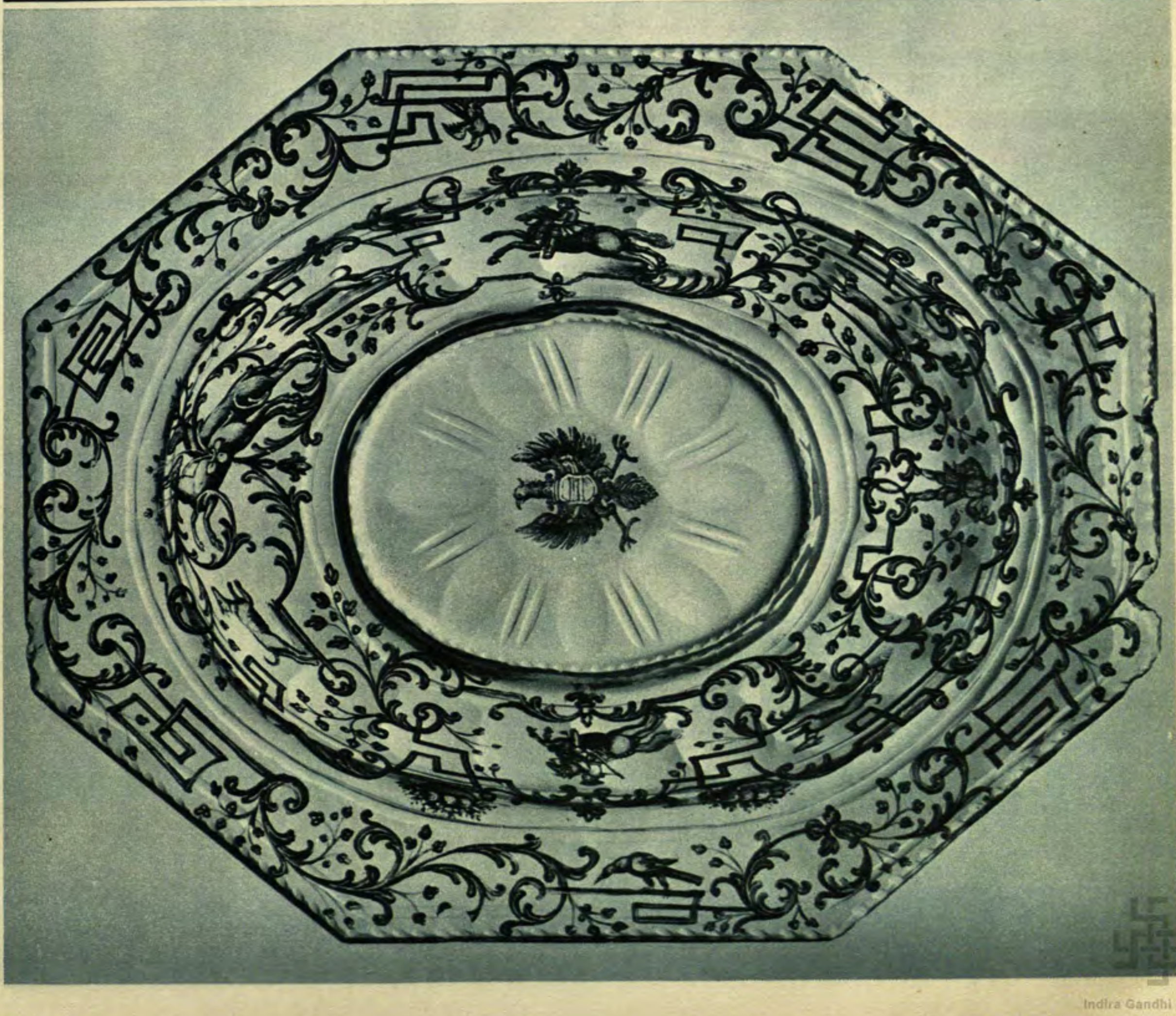
208. J. Schaper (?): Black-Enamelled Beaker from the Years 1660—1670. Germany. (PACM)



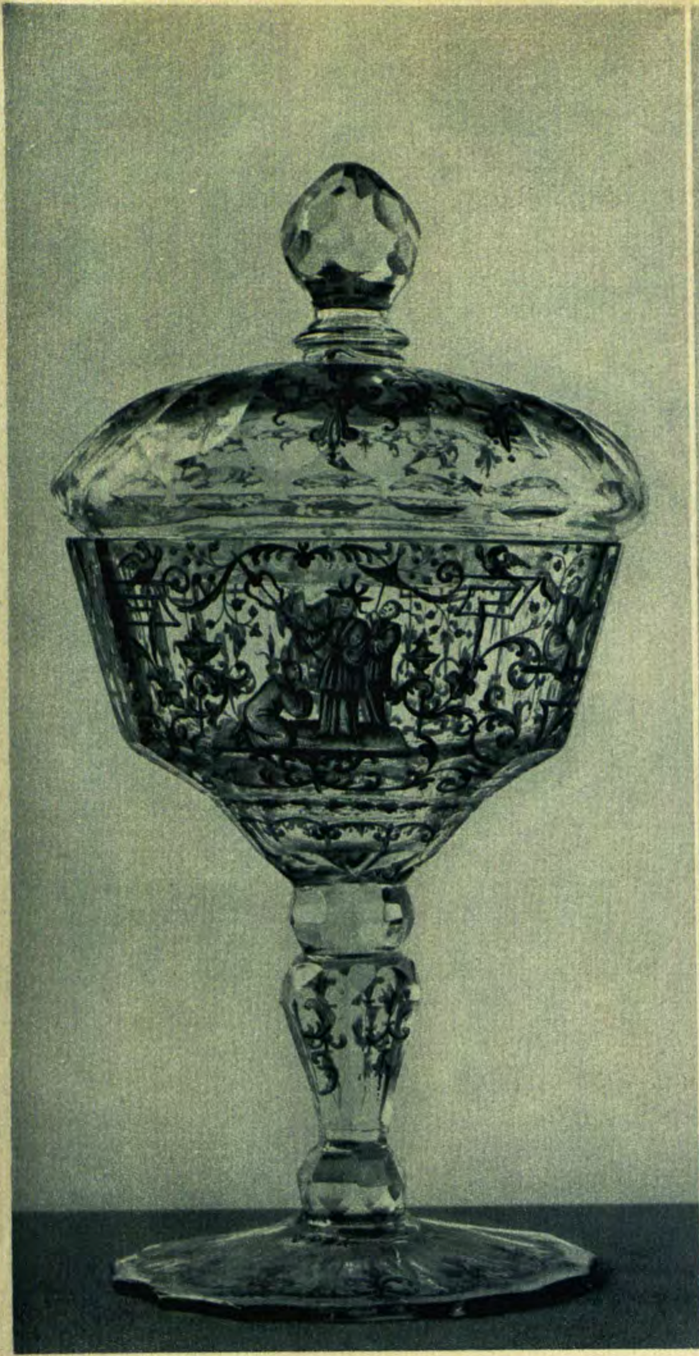
209. Relief Cut and Engraving on Gold-Ruby Vessels, Set with Silver, All from the Years 1710 to 1720. (From R. Schmidt's Work.)

210. Ignatz Preissler: Flacons and Jugs with Black Painting; Hunting Motifs. Kunštát, About 1725—1730. (PACM)

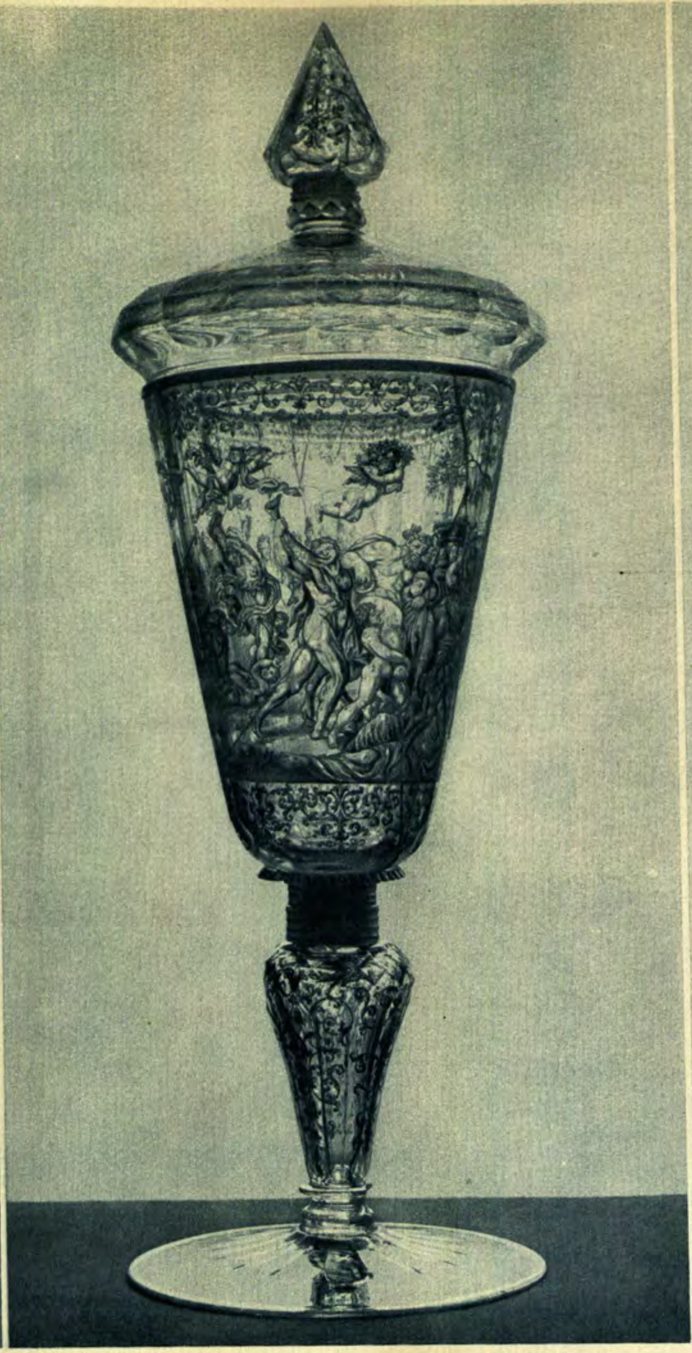




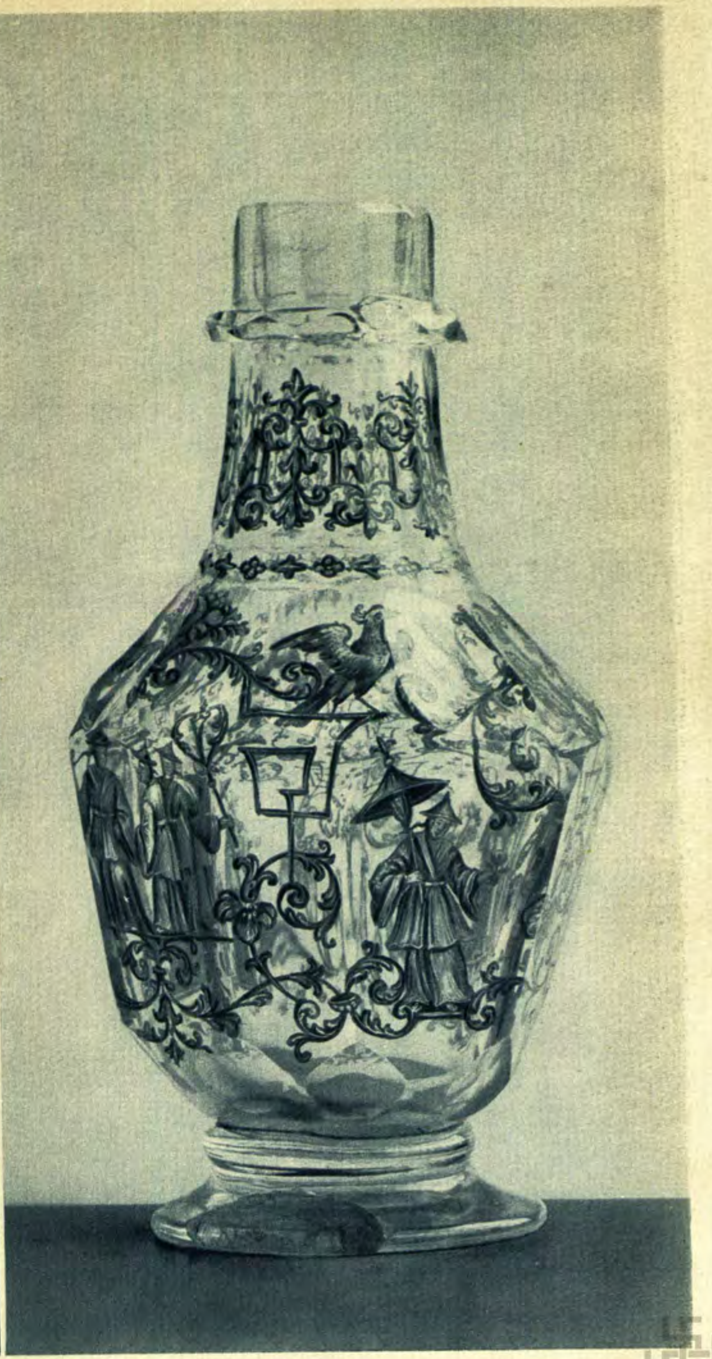
211. Preissler: Dish, Decorated with Black Enamel and Gold-Inlaid Grotesques. Kunštát, About 1720. (PACM)



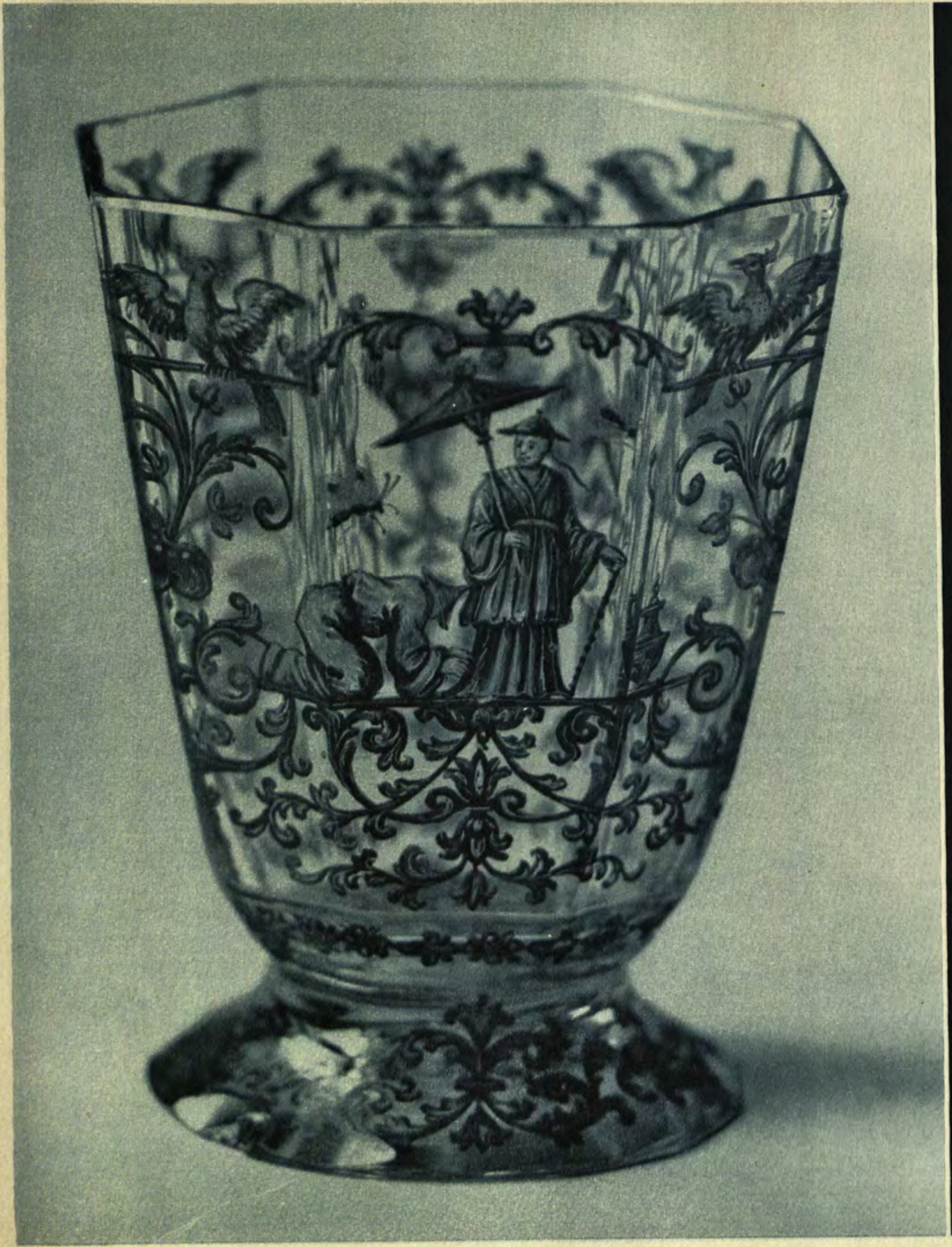
212. Preissler: Jug with Lid, Painted in Black and Gold. Bohemia, About 1725. (PACM)



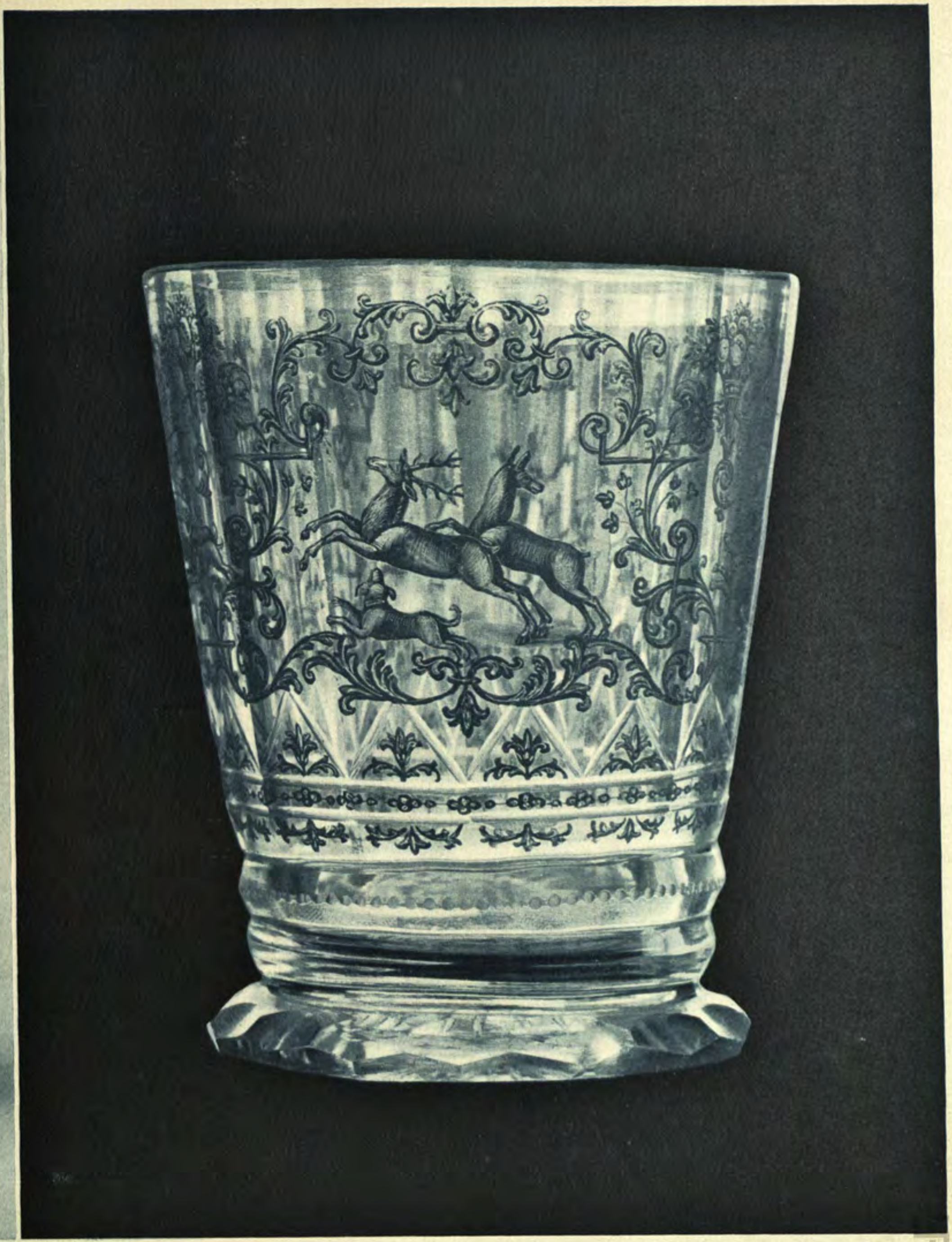
213. Preissler: Goblet Painted in Black Paint. About 1725. (PACM)



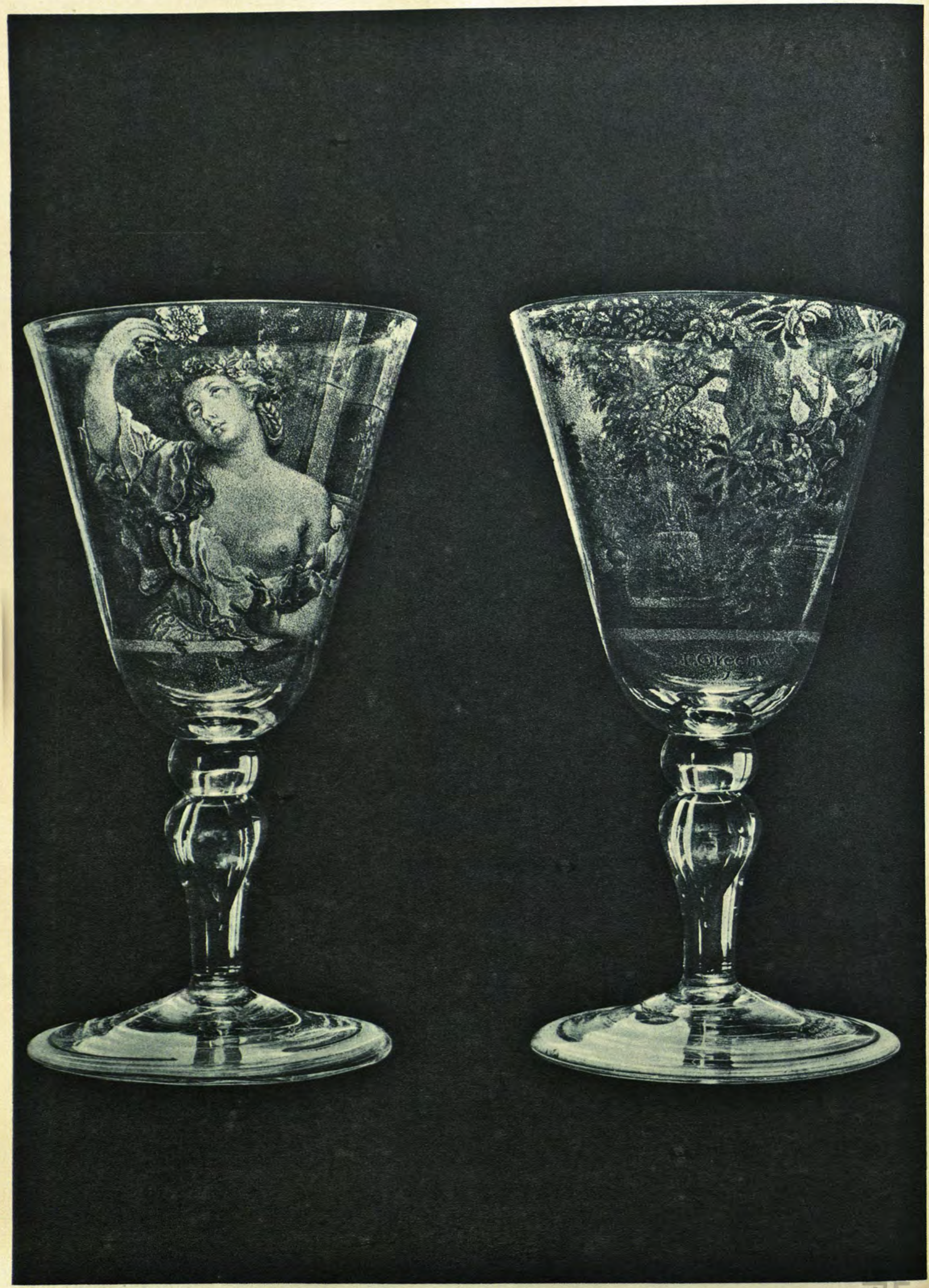
214. Preissler: Glass Carafe, Black-Gold Painting. Bohemia, About 1725. (PACM)



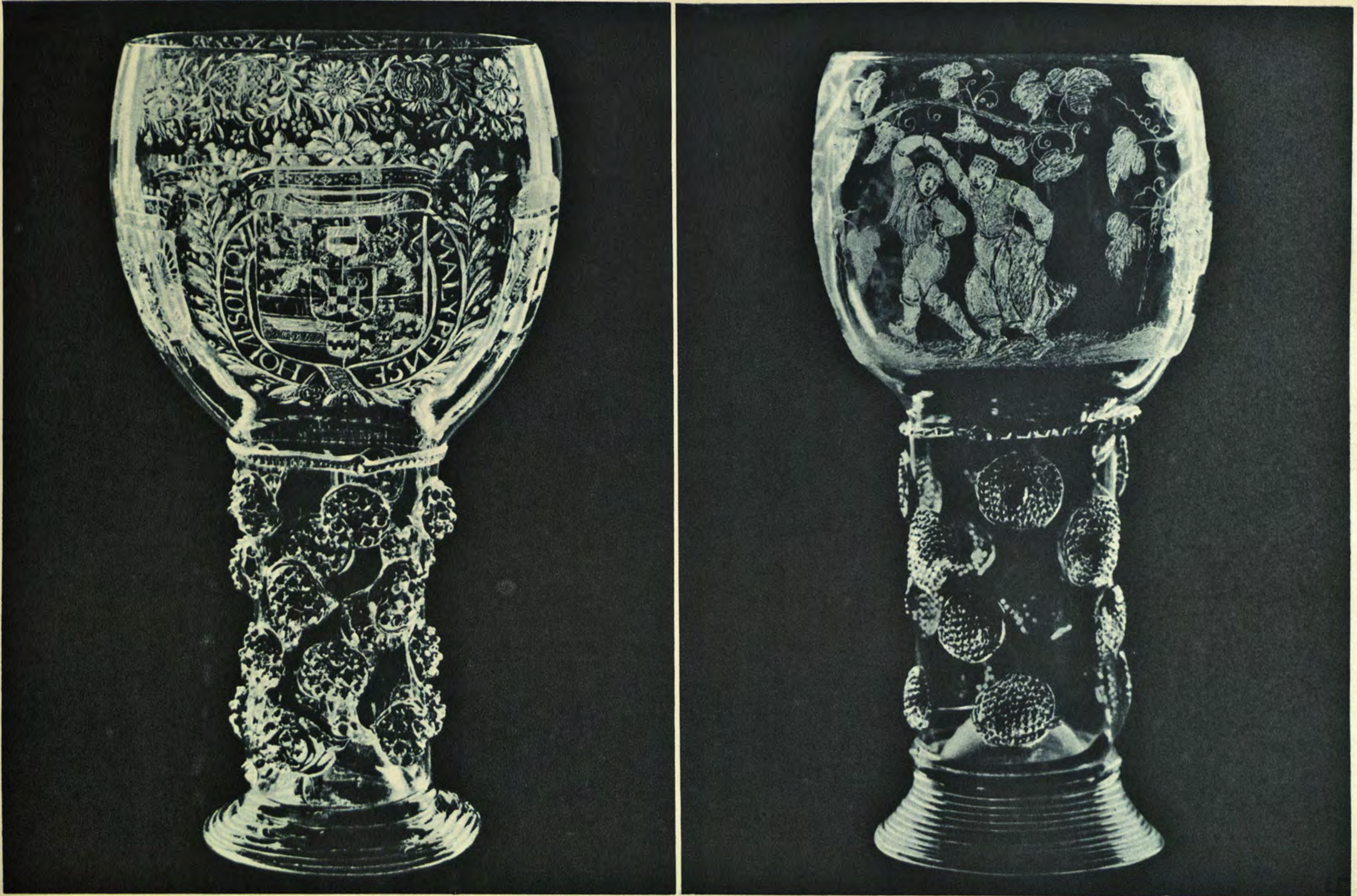
215. Preissler: Octagonal Painted Beaker with Black Chinese Decorations. Photo: ÚLUV.



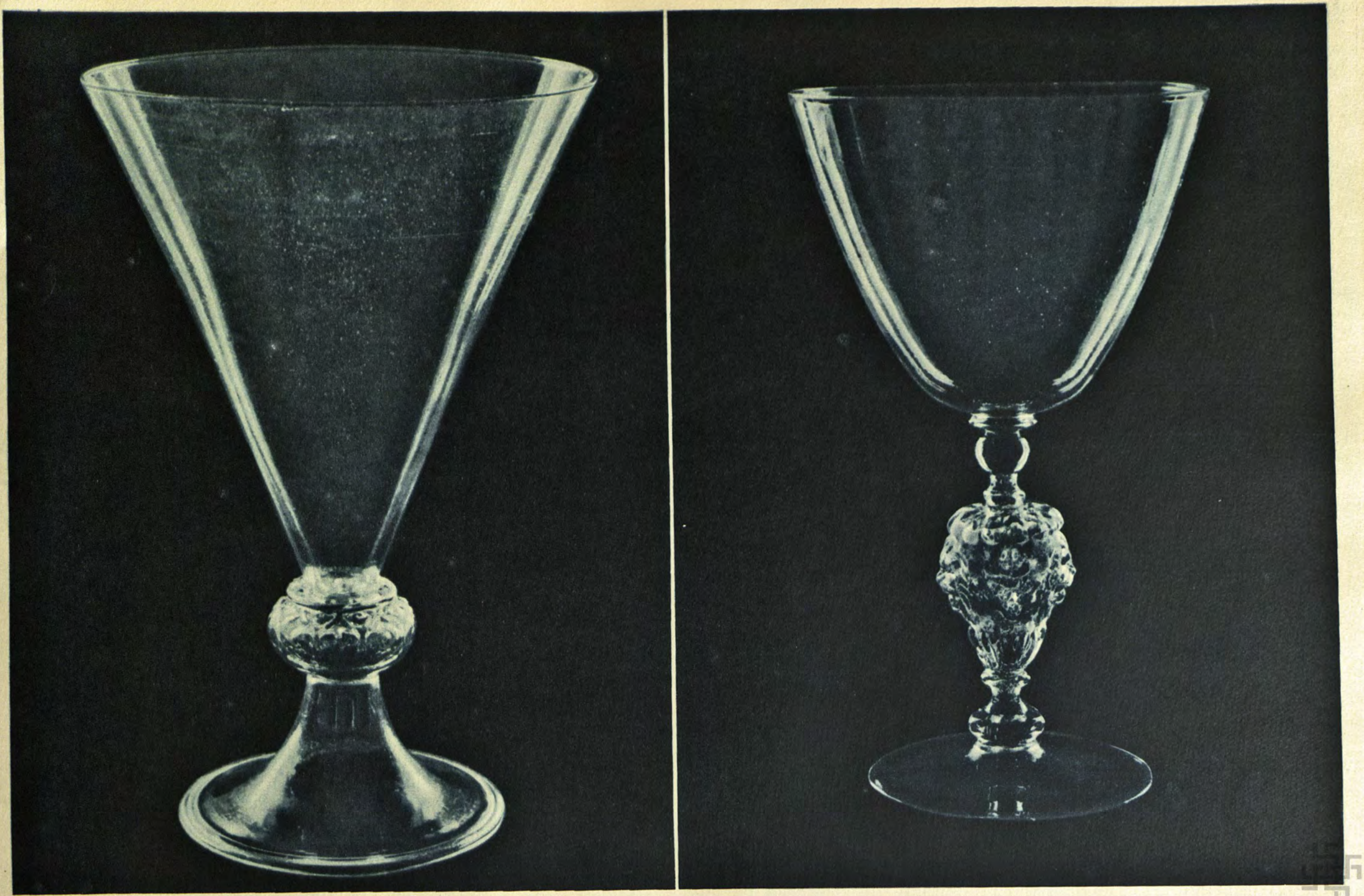
216. Preissler: Black Painted Glass. Castle Hluboká, Bohemia, About 1730. (PACM) Photo: ÚLUV.



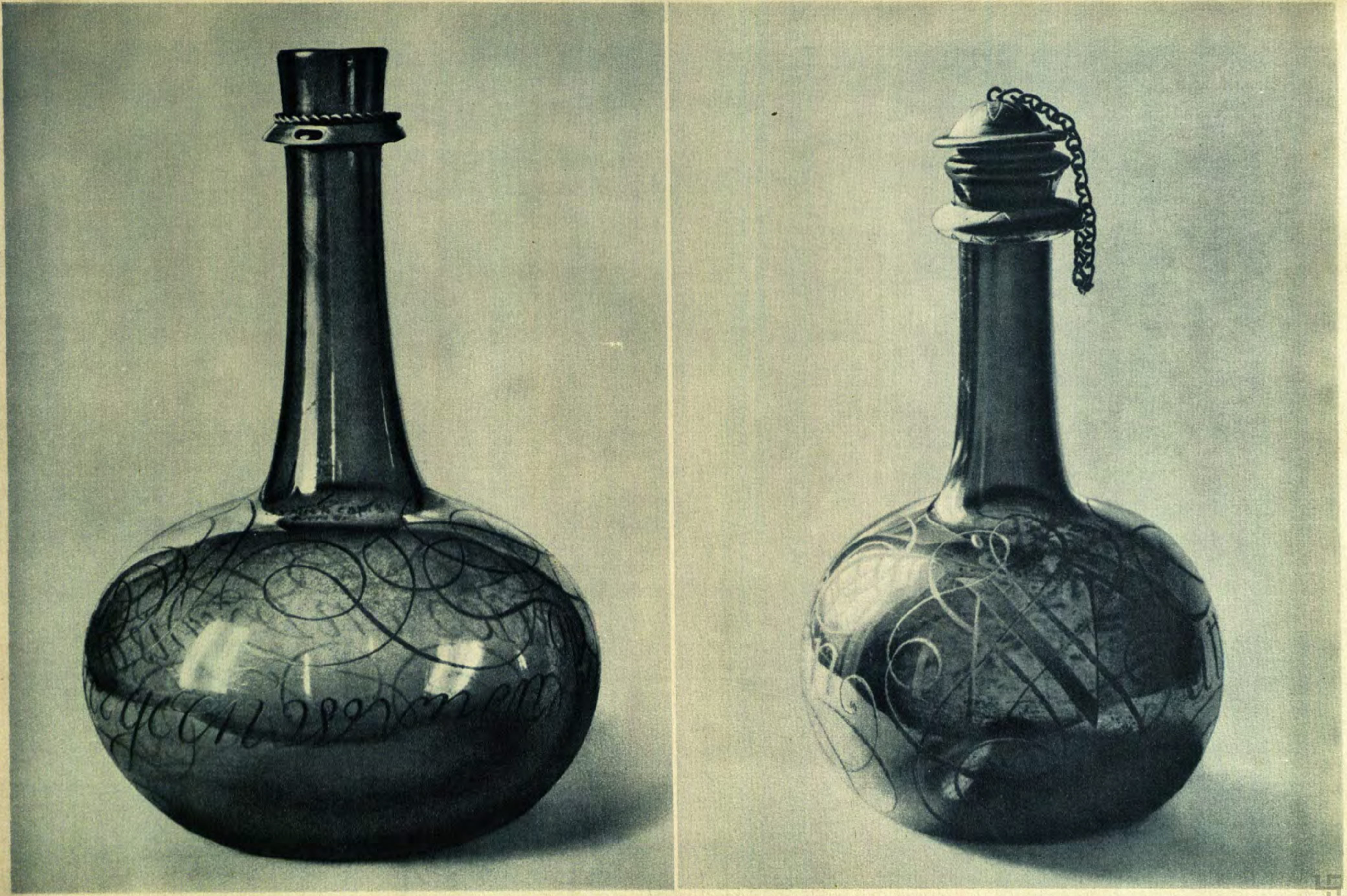
217.—218. Two Dutch, Diamond-Stippled Glasses. 1728. Goddess "Maas" and a Garden.



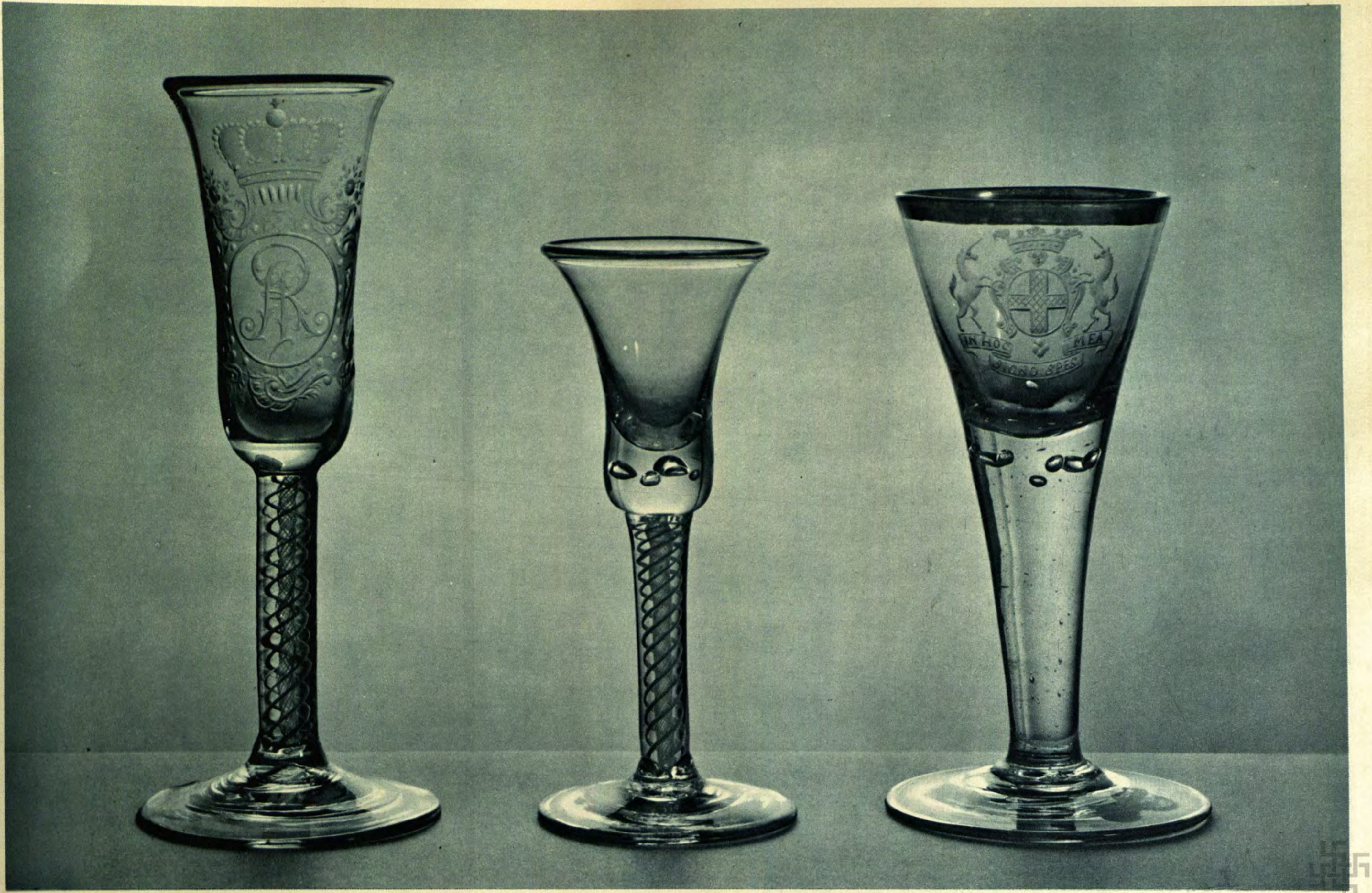
219.—220. Two Green "Rummers", Diamond Engraving with Fired-on Decorations of Raspberries. Second Half of 17th Cent.



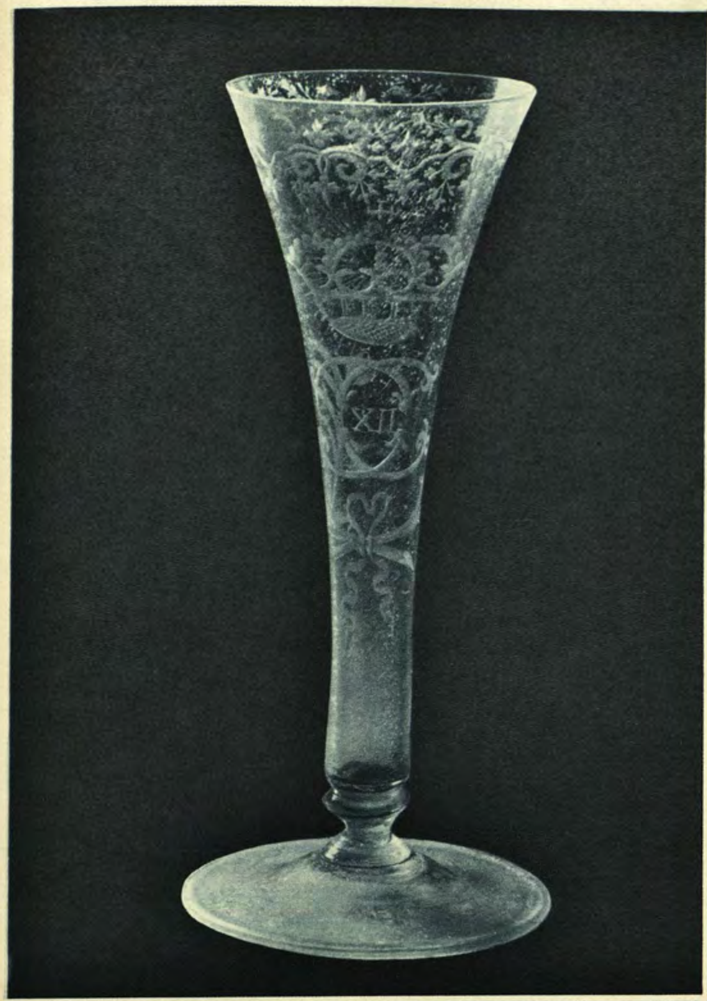
221.—222. *Venetian or Dutch Beakers with Relief Stems. 16th or 17th Cent.*

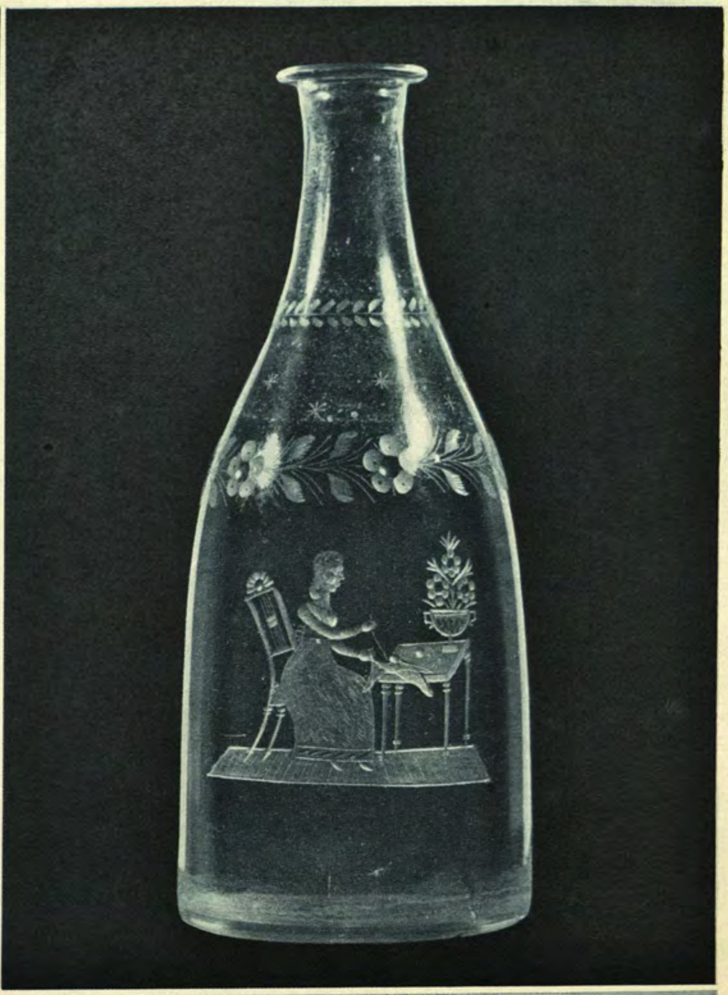


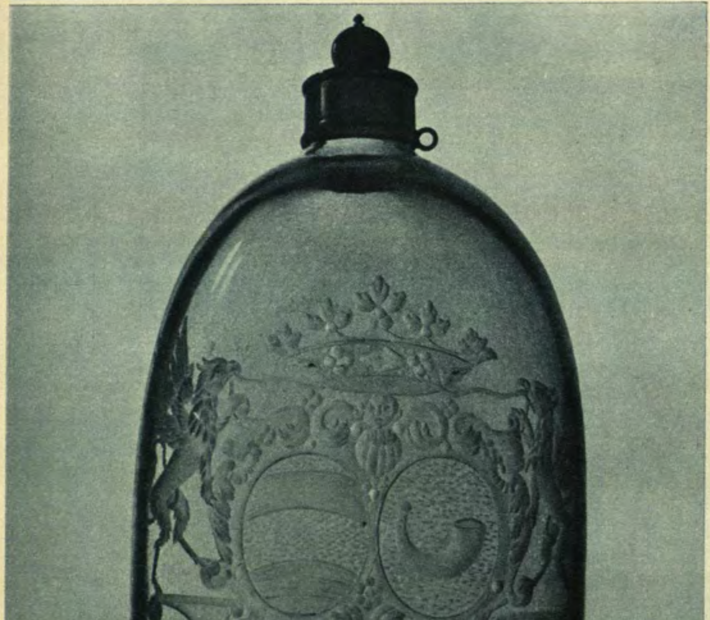
223.—224. *Two Green Dutch Glass Flasks, one with a Tin Lid with a Chain, with Diamond-Engraved Inscriptions. Producer: Willem van Heemskrecht, Leyden, 1674 and 1684.*

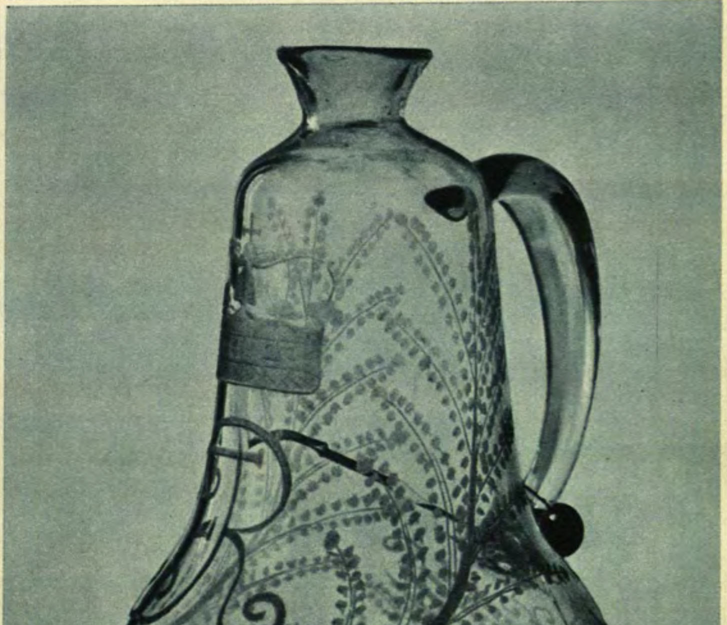


225.—227. *Three Old English Glasses. (PACM) Photo: J. Brok, Prague.*

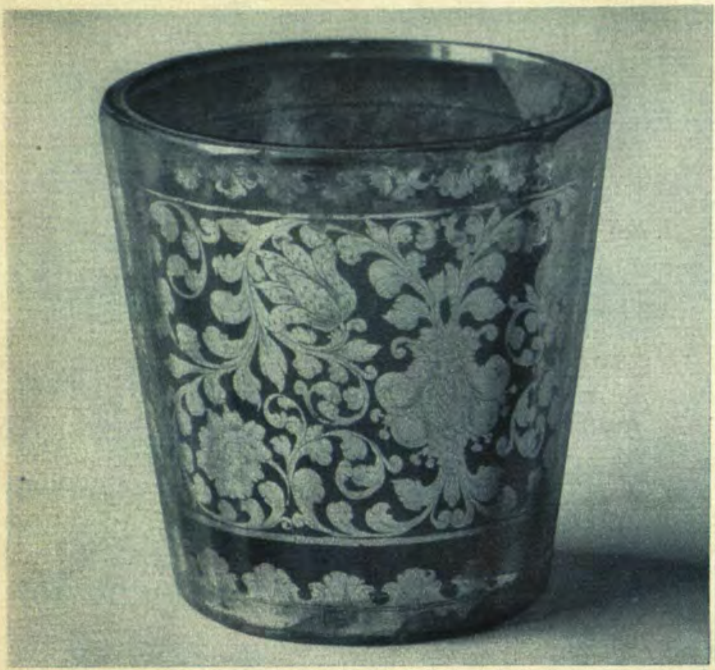


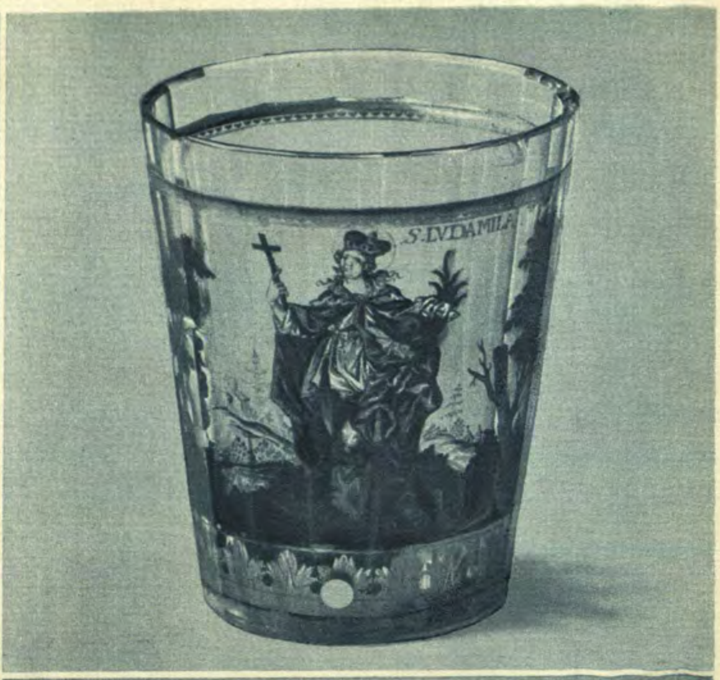


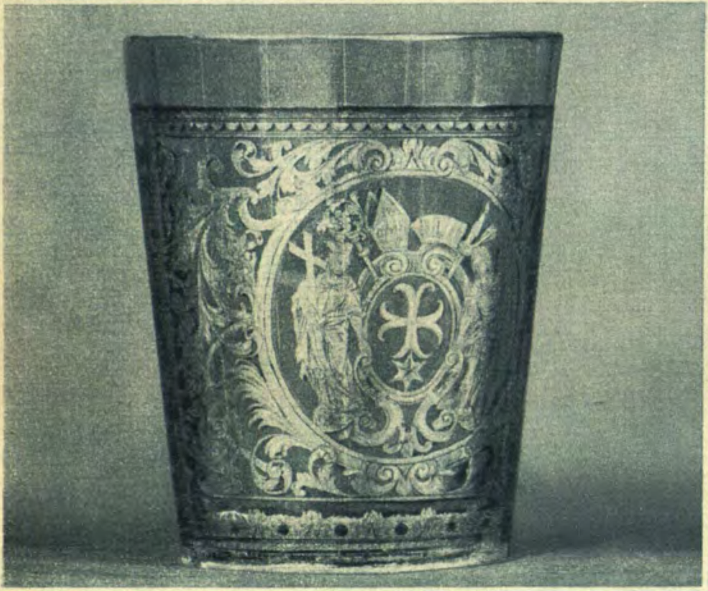


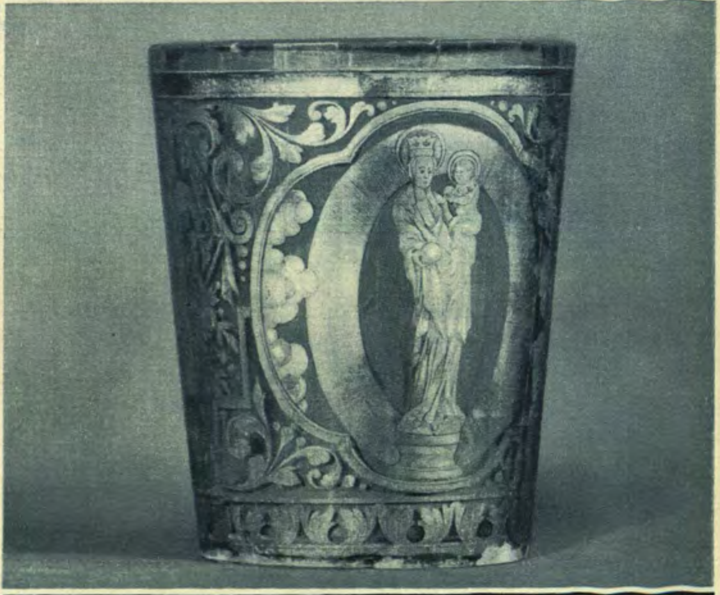


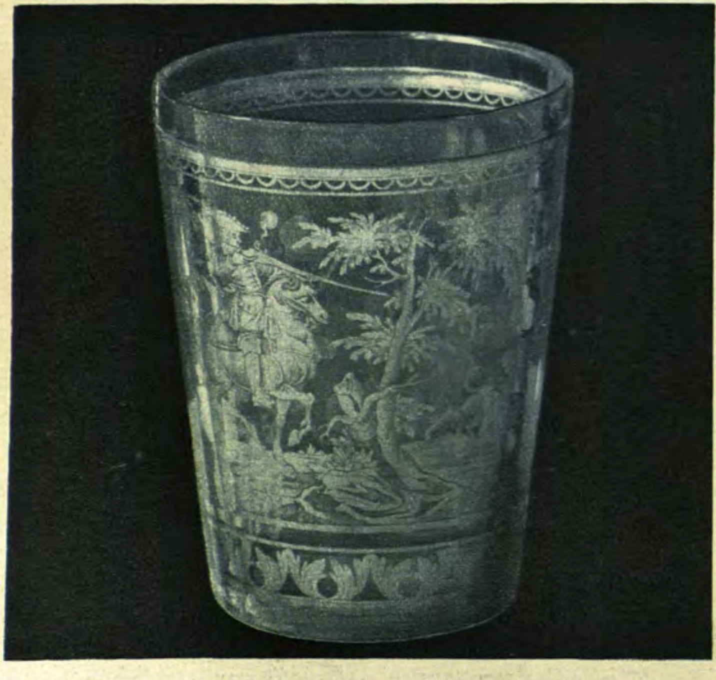
228. Swedish Wine Glass, Engraved. Monogram of King Charles XII. 229. Old Swedish Water Carafe, Engraved. 230. Old Swedish Flask with Engraved Coat-of-Arms. 1705. 231. Old Swedish Decanter, Engraved.

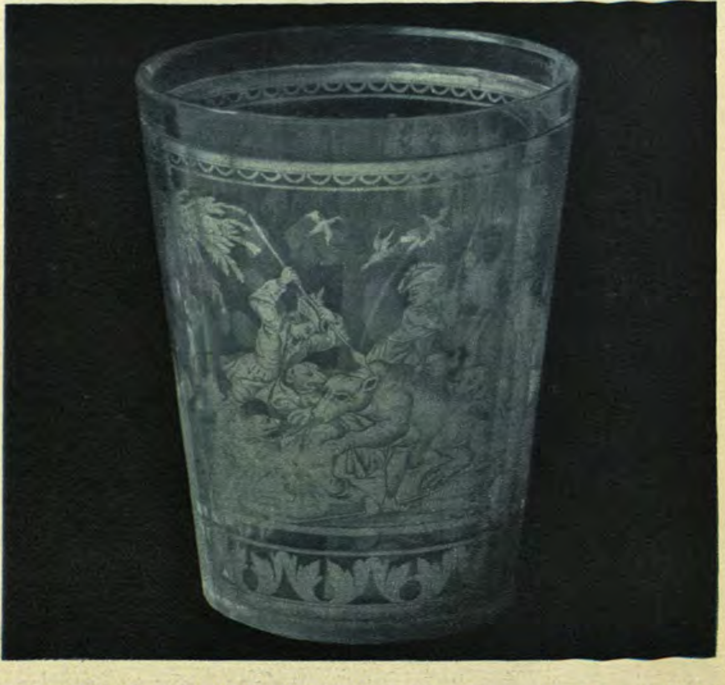




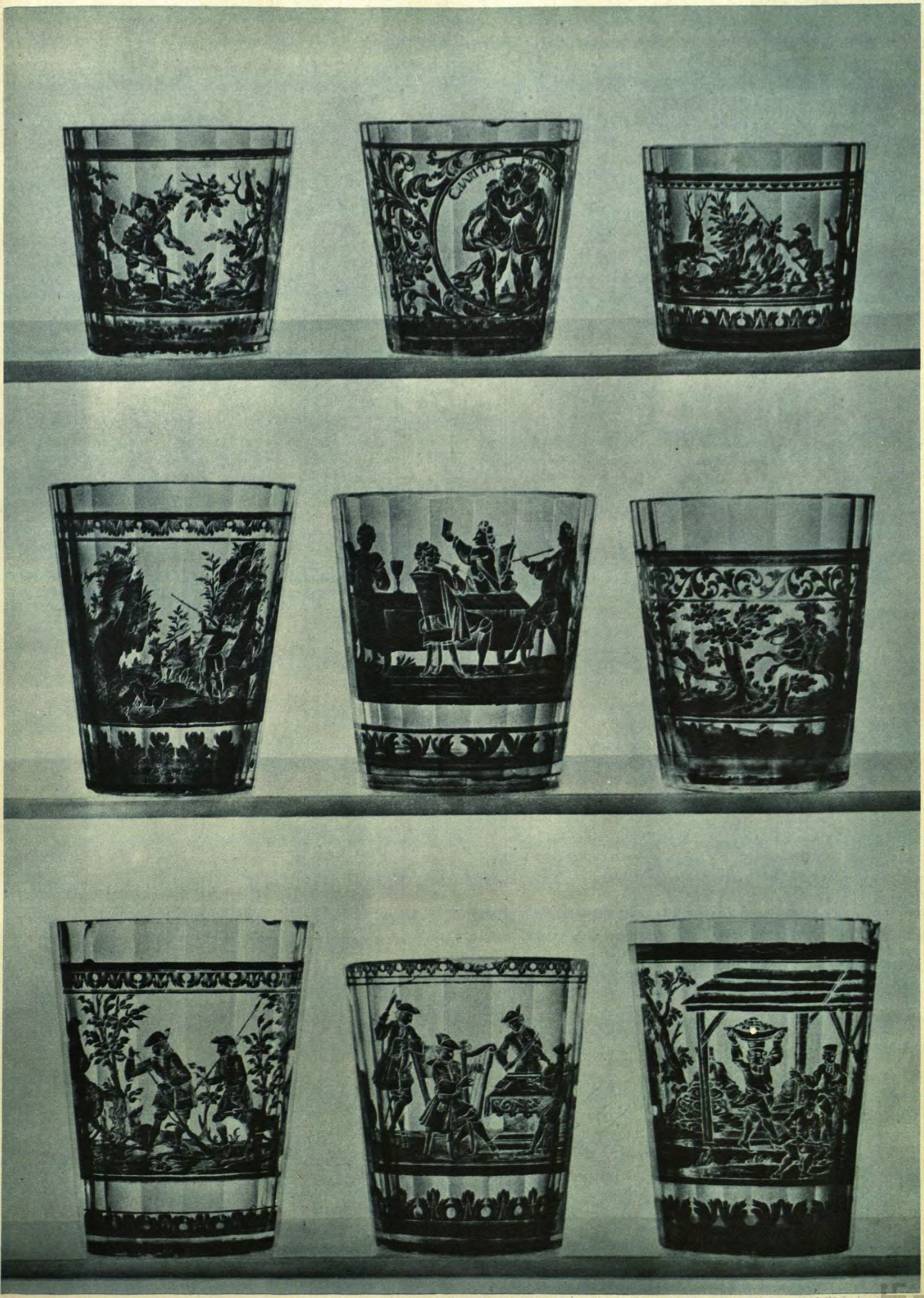




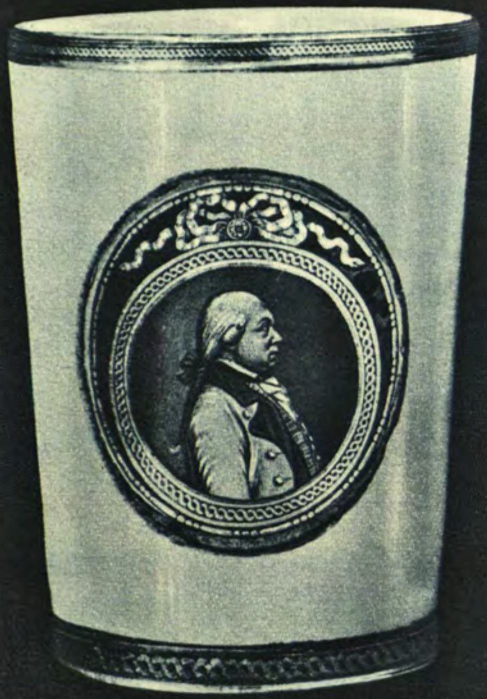


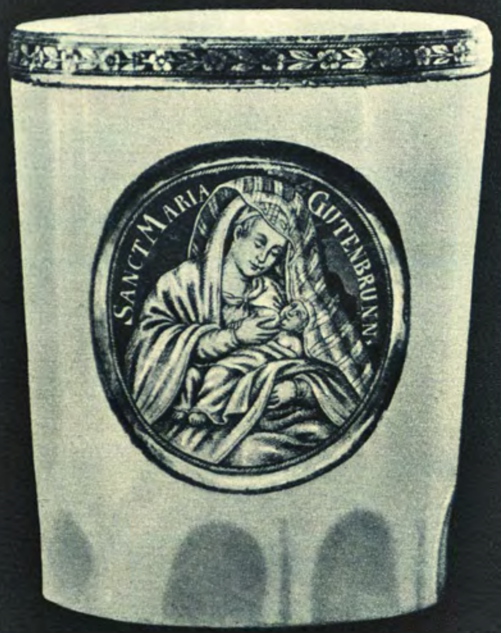


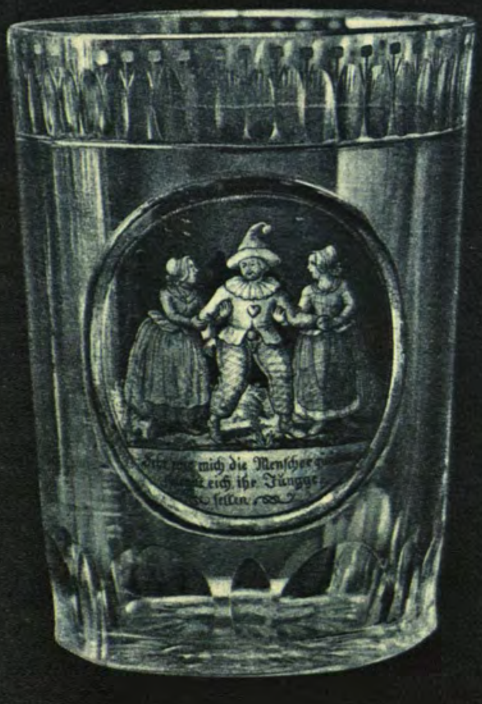
232. Double-Walled Glass. The Space between the Walls is Coloured with Red Enamel. Gold Decorations. The Bottom is Decorated with an Equestrian Picture. Bohemia, 1730. Photo: ÚLUV. 233. Double-Walled Glass with Transparent Enamel Painting. Picture of St. Ludmila. First Half of 18th Century. (PACM) Photo: ÚLUV. 234.—235. Double-Walled Glasses, Bohemia, About 1740. On the Left the Prague Crusaders, on the Right the Madonna of Hejnice (Hainsdorf). (PACM) 236. Small Double-Walled Glass with Gilded Hunting Scenes (Bear Hunting). On the Bottom There is a Hare. Bohemia, 1730. (PACM) 237. Back View of Same. Photo: J. Otto, ÚLUV.

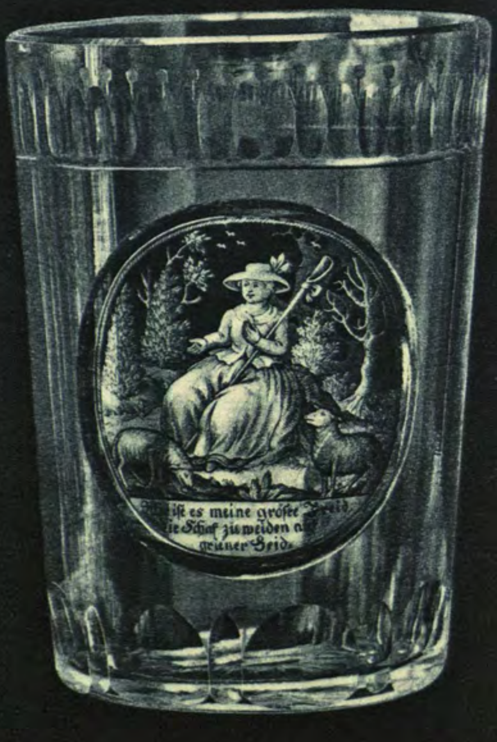


238. Bohemian Double-walled Glasses with Scenes from Feudal Life, Scratched into Gold Folio. About 1730.

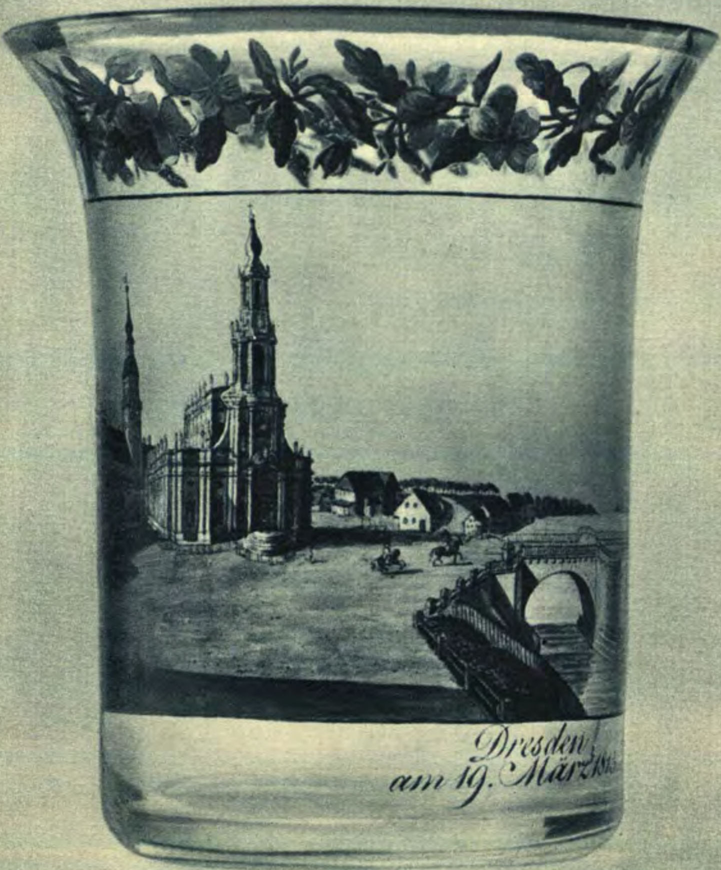


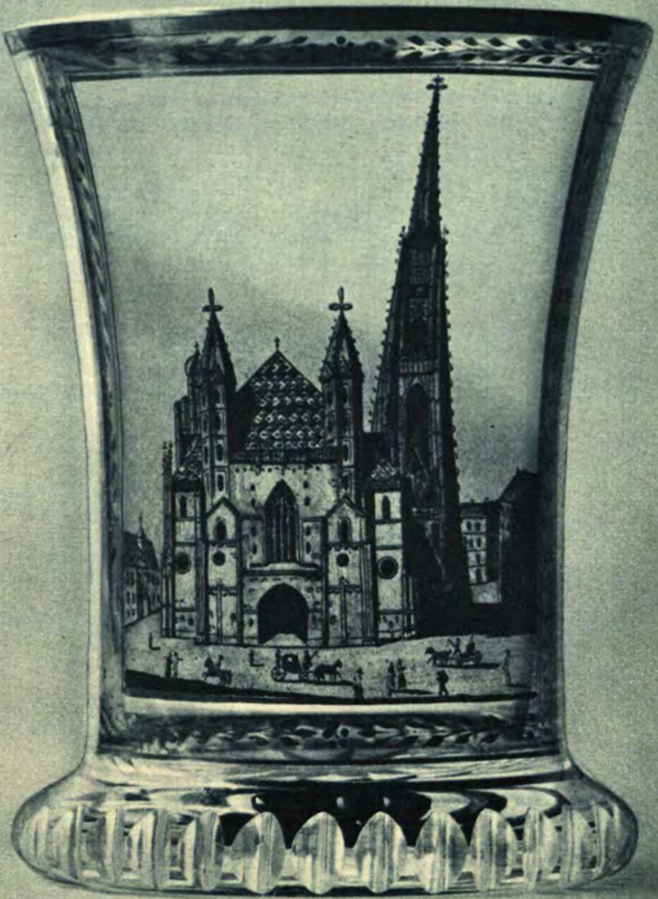


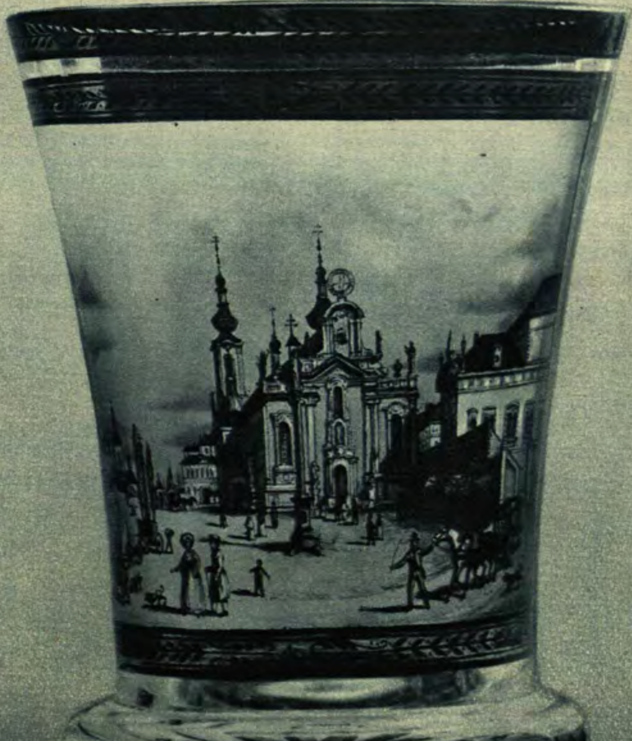


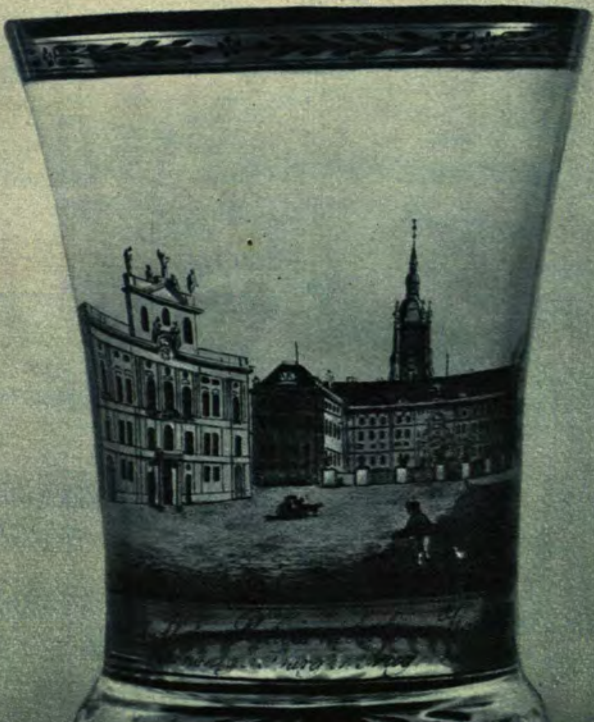


239. *J. J. Mildner: Milk-Glass with Portrait of the Squire of Fürnberg 1788.* 240. *Mildner: Milk-Glass, Madonna with Christ Child. About 1788.* 241. *Mildner: Milk-Glass, A Fool with Two Women, 1789.* 242. *Mildner: Picture of a Shepherdess. About 1788.*

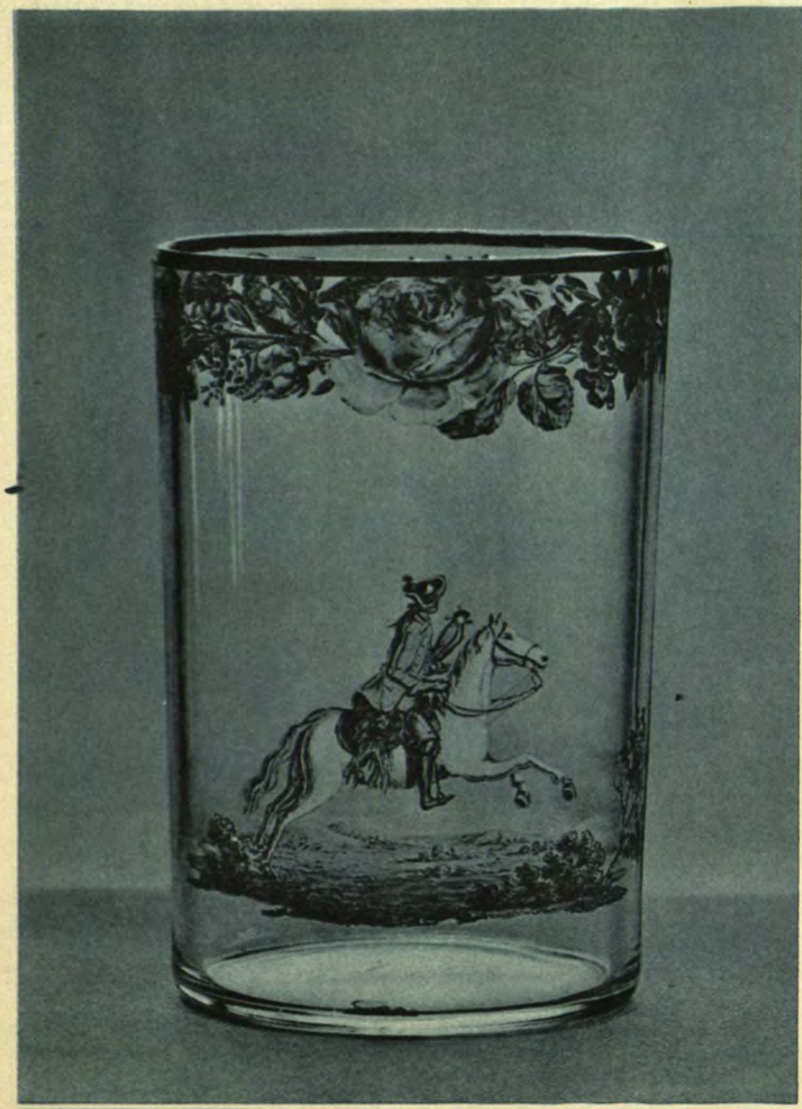


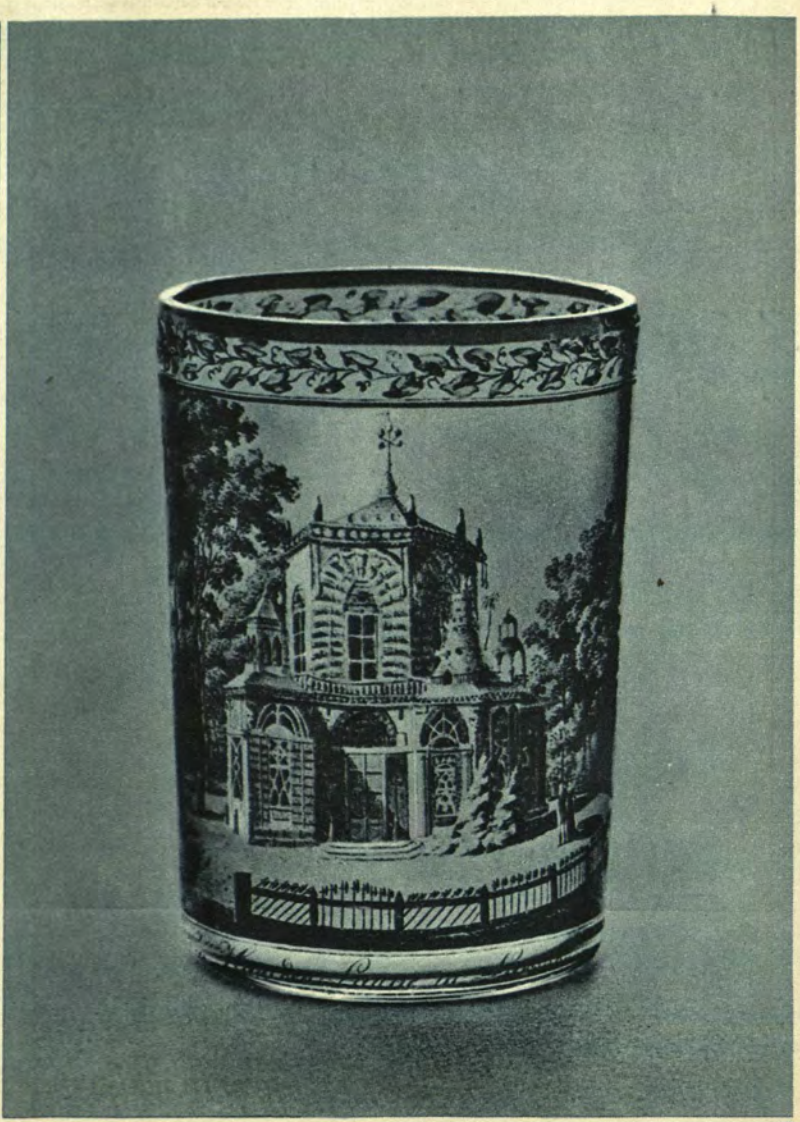


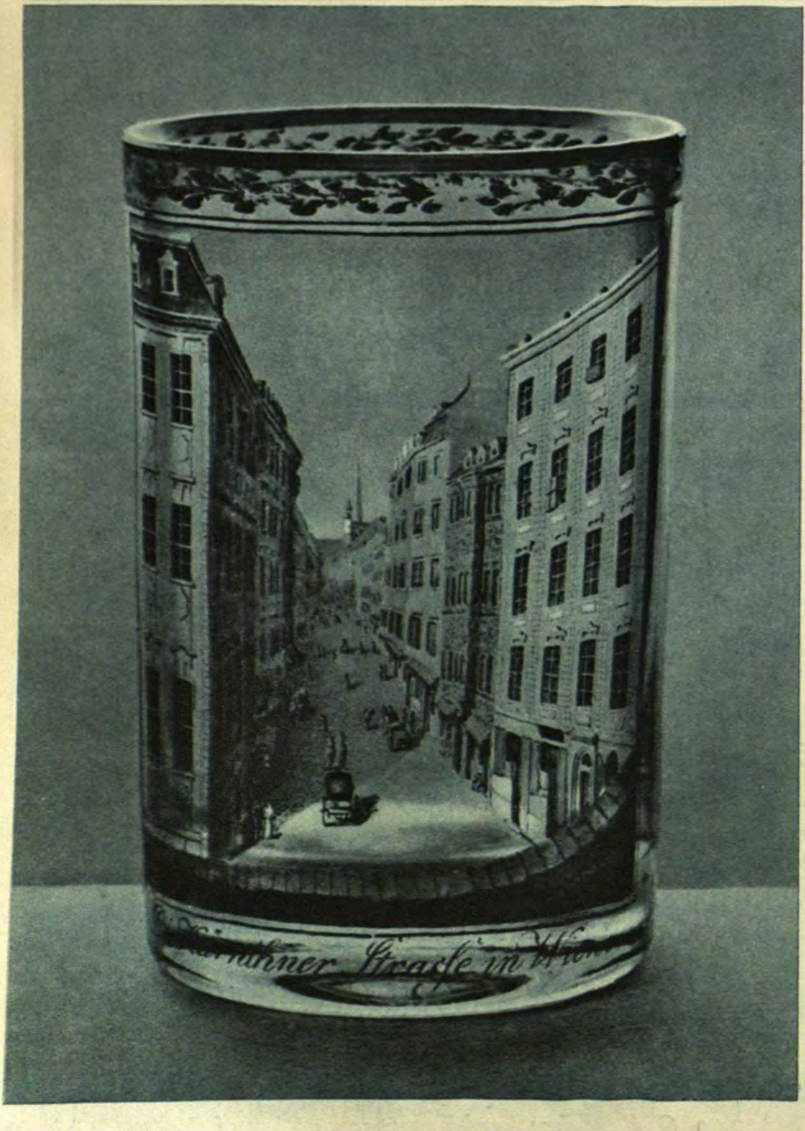


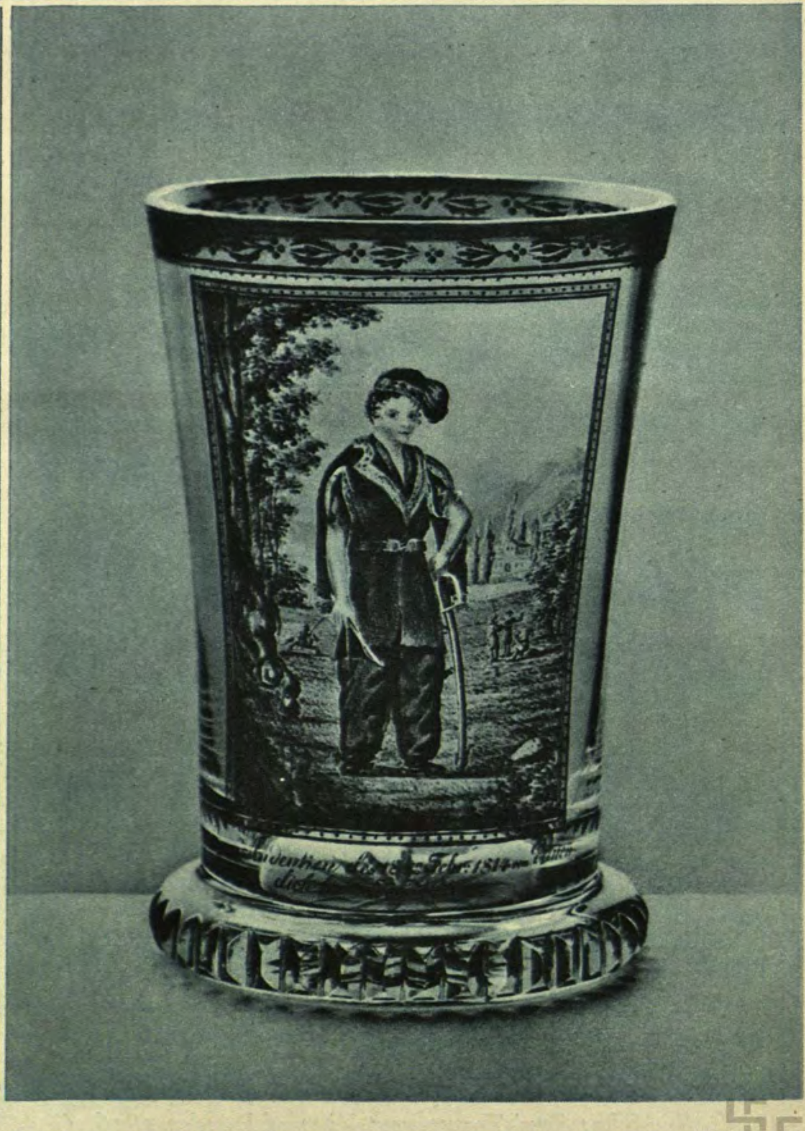


243. G. S. Mohn: Semi-Transparent View of Dresden 1816. (PACM) 244. G. S. Mohn: Semi-Transparent View of the St. Stephens' Cathedral in Vienna. About 1825. (PACM) 245.—246. Semi-Transparent, Painted Glass. To the Left the Yard at Strahov, to the Right the Castle Square in Prague. Painted: L. Hoffmeister and A. Kothgasser. Beginning of 19th Cent. City Museum Prague.

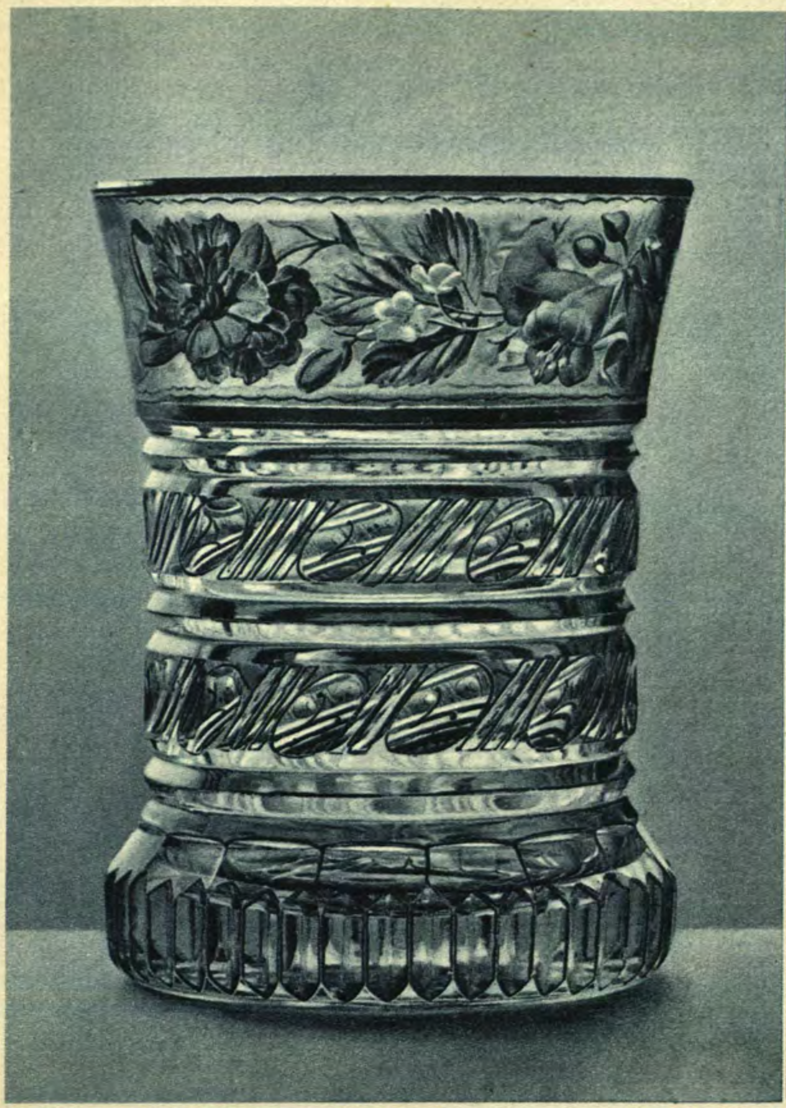


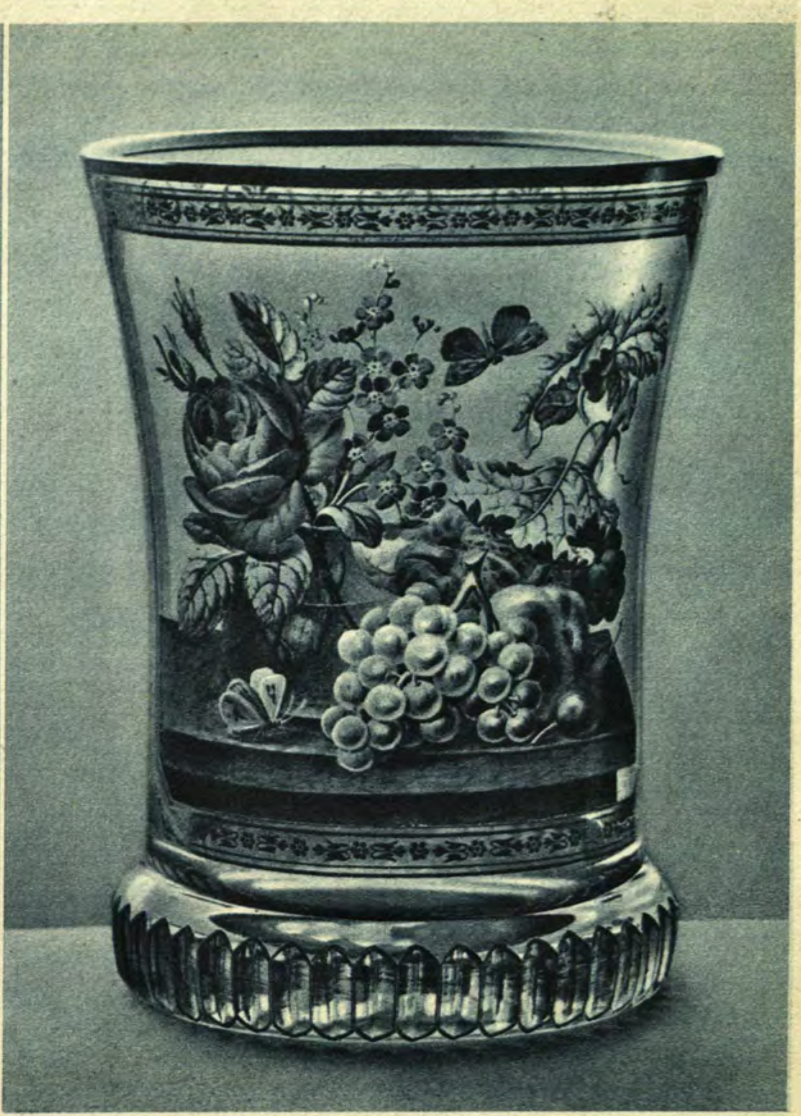


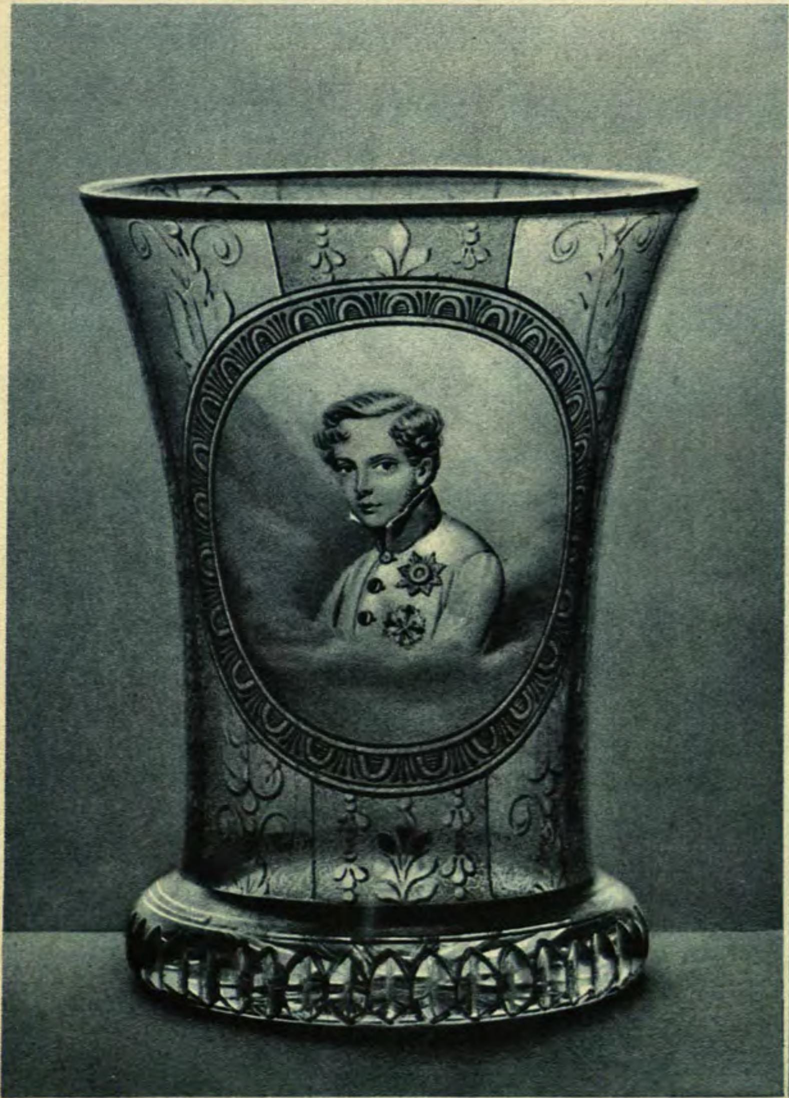


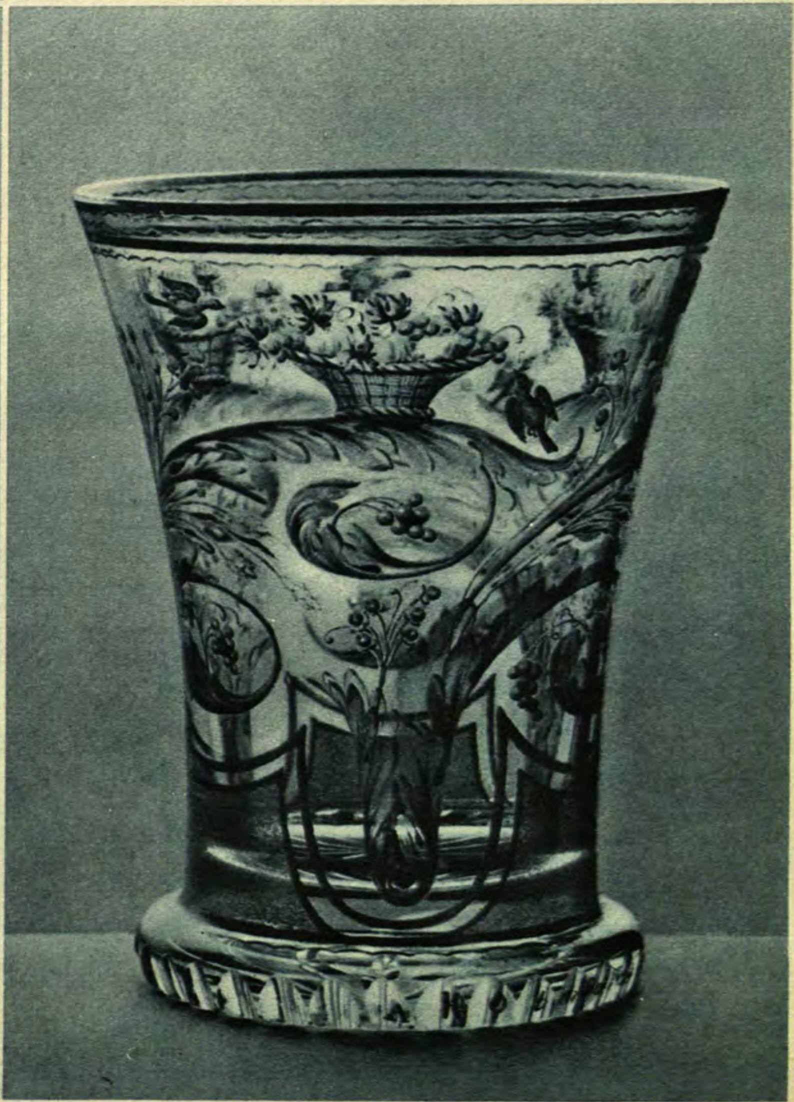


247. Gottlob Mohn: Hunter on Horse-Back. 1818. 248. Gottlob Mohn: View of Laxenburg. 1812. 249.—250. Gottlob Mohn: The Kärntner Street in Vienna. 1814. — Painted and Cut Glass with a Cossack. 1817.

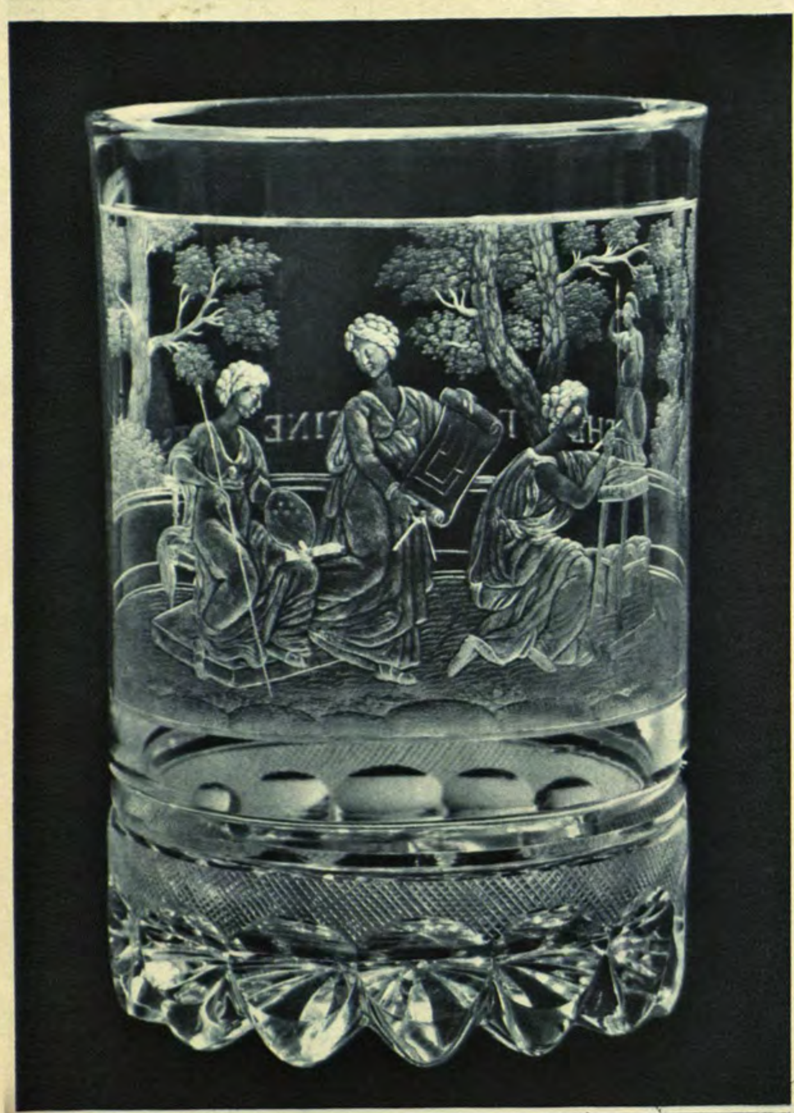


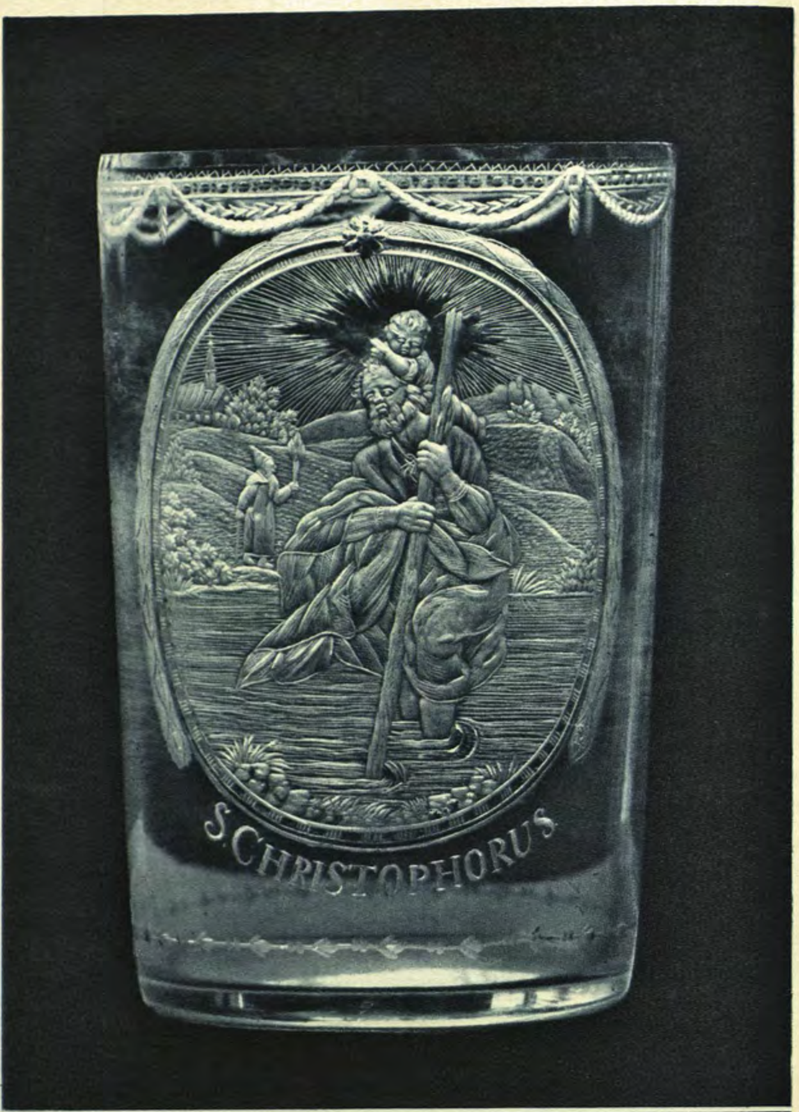


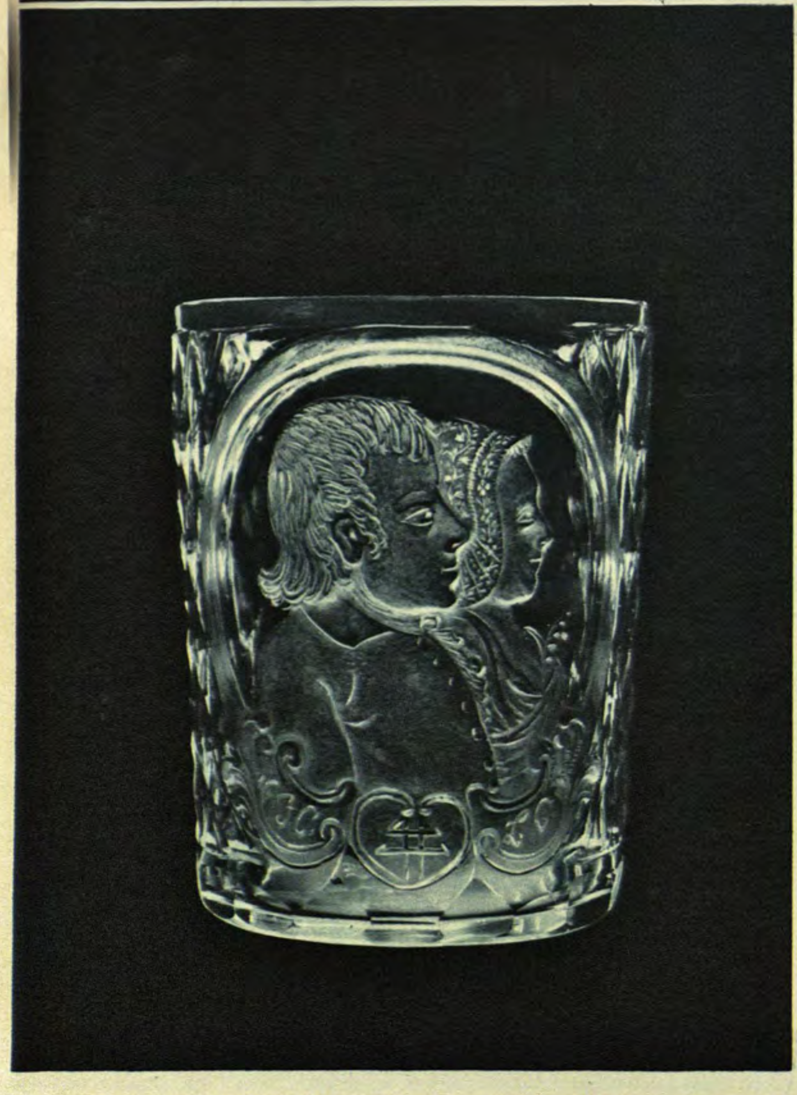


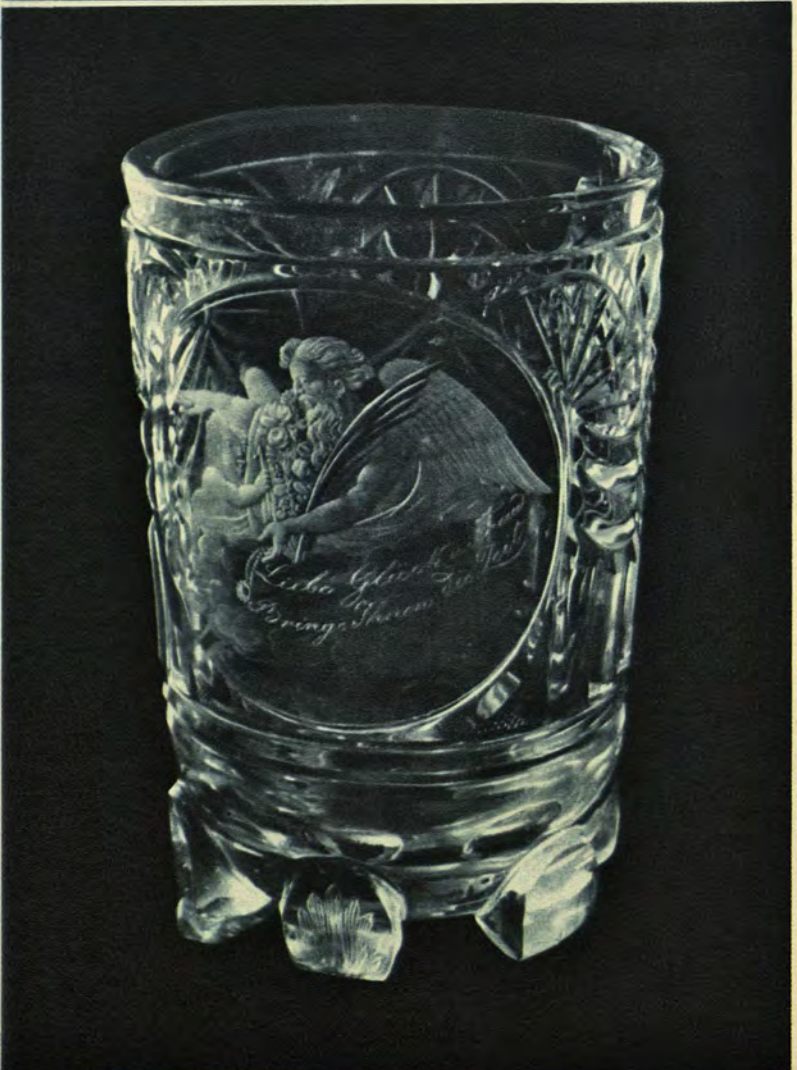


251.—252. *Ant. Kothgasser: Cut and Painted Glasses.* 253. *Ant. Kothgasser: Glass with the Portrait of the Duke of Reichstadt.* 1832.
254. *Ant. Kothgasser: Cut and Painted Glass, About* 1835.

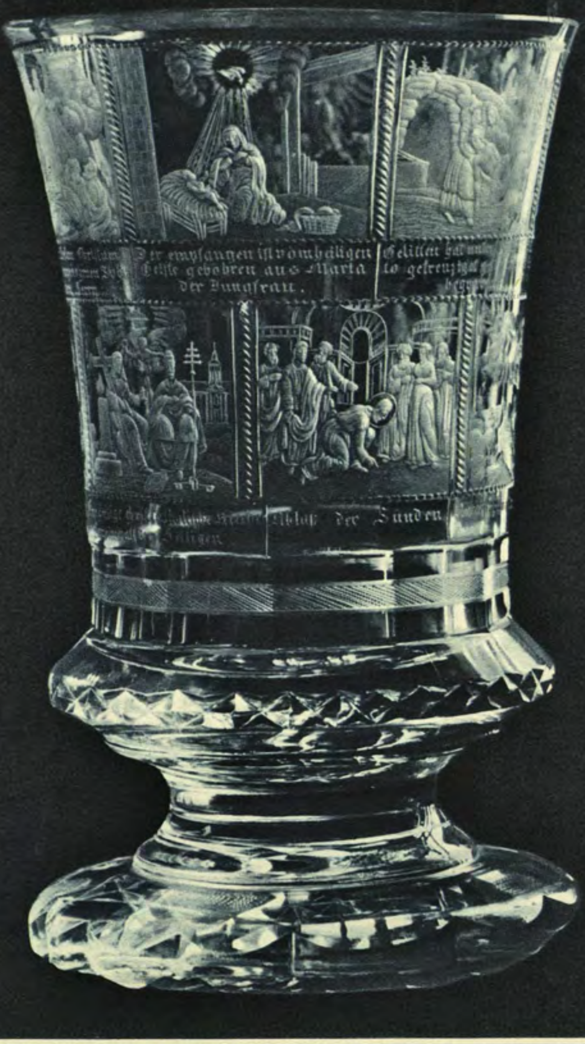


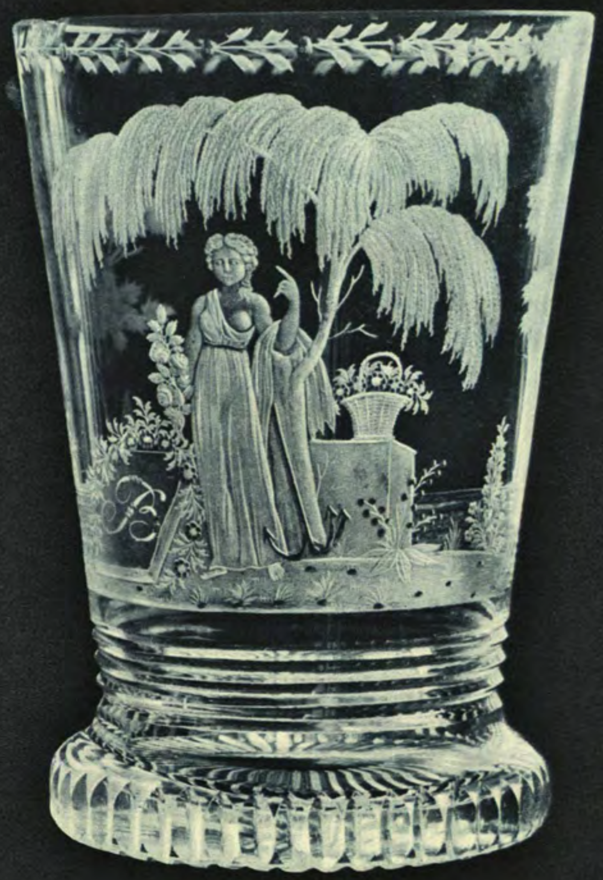


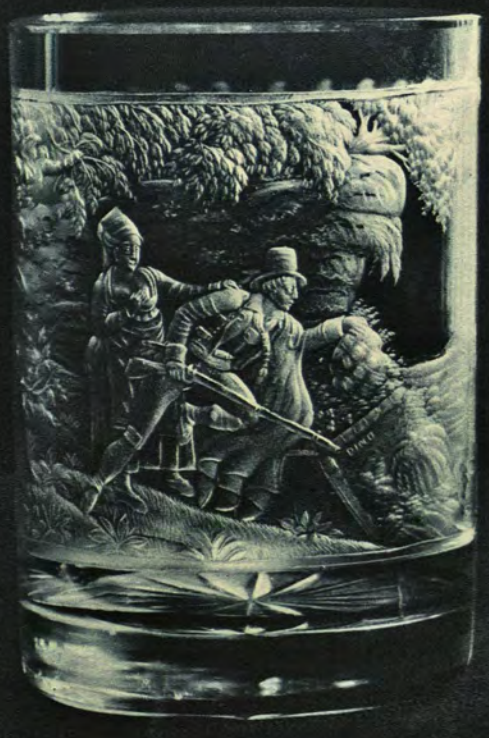


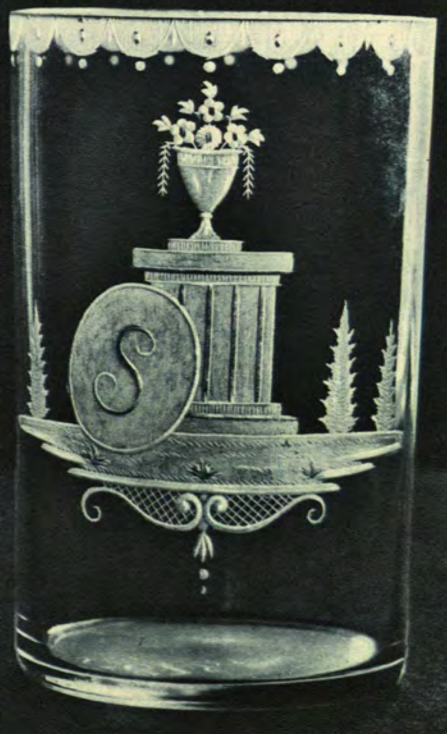


255. Cut and Engraved Glass with Figural Decorations and Inscription. Glass-House Milovary, Middle of 19th Cent. Photo: ÚLUV - J. Otto. 256. St. Christophorus. Engraved by Master I. R., About 1810. 257. Relief Glass with the Portraits of the Newly-Married Couple, the Vogels. North Bohemia. End of 18th Cent. (PACM) 258. Cut and Engraved Empire Glass. Beginning of 19th Cent. (Private Collection.)

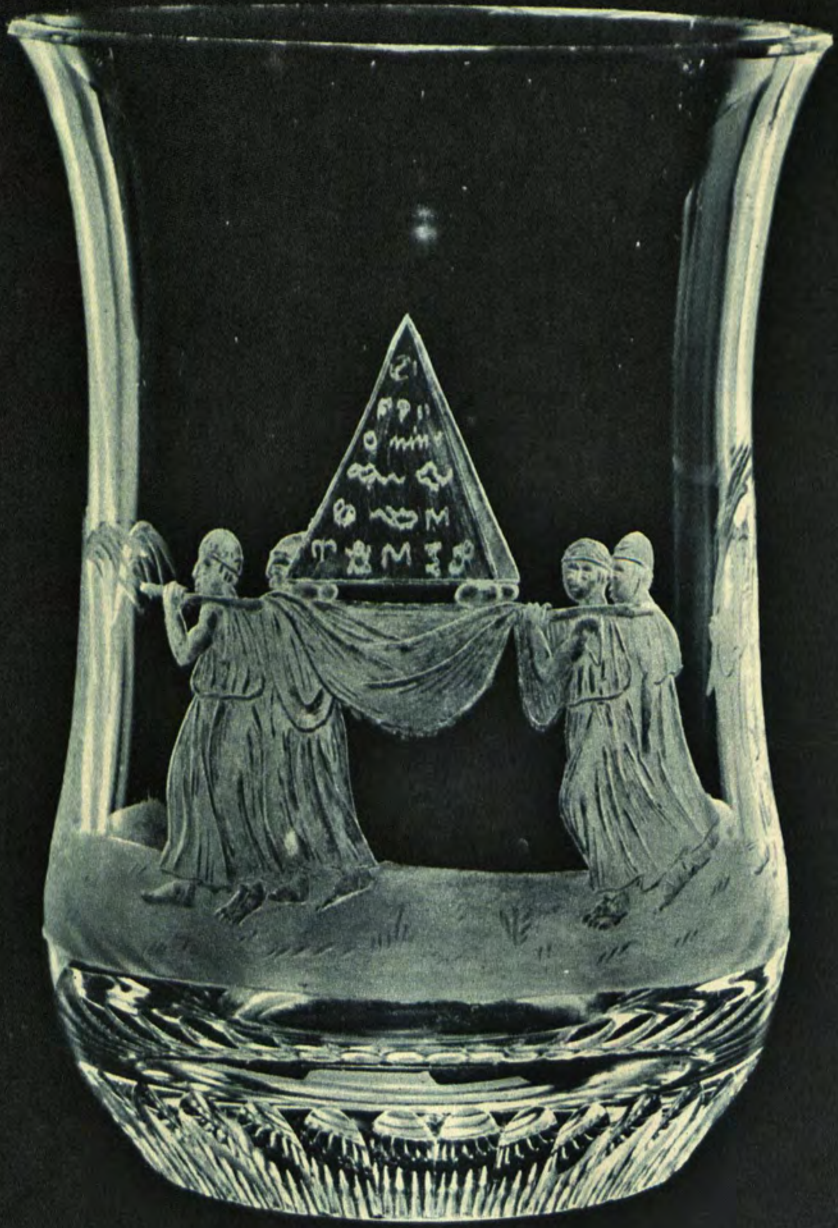

Der empfangen ist vom heiligen Geiſte geboren aus Maria der Jungfrau.
Ablaß der Sünden



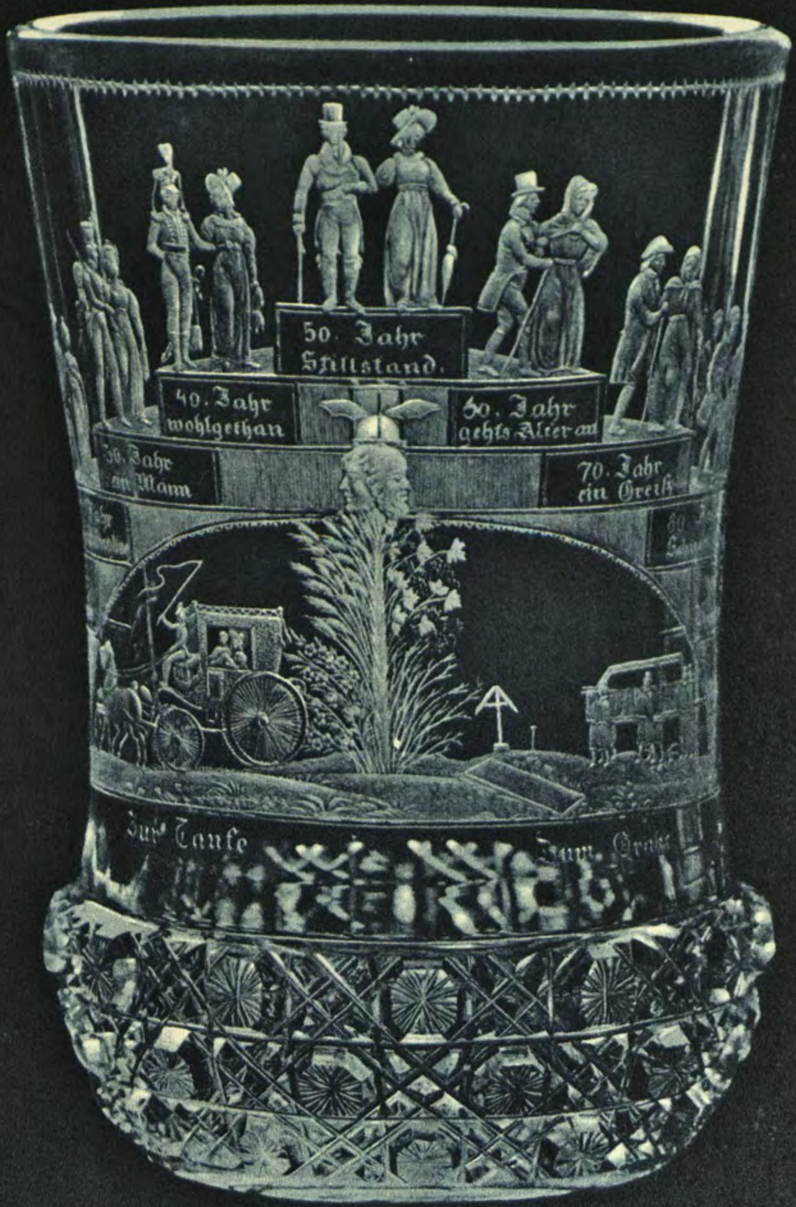




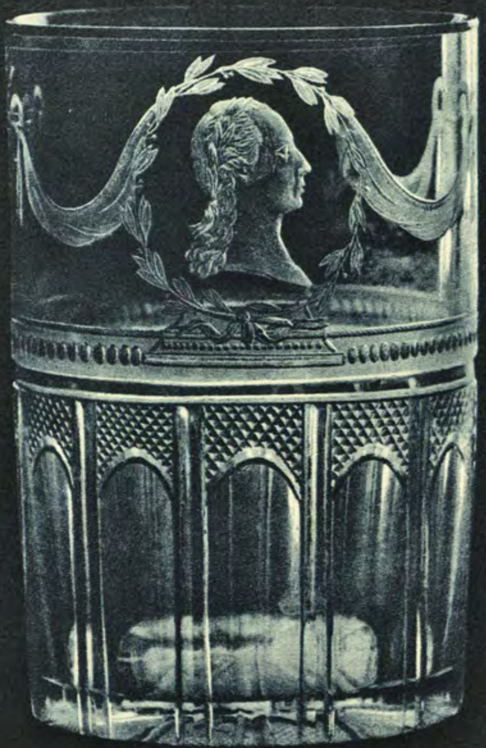
259. *Cut and Engraved Glass, the Articles of Faith. Bohemia. Beginning of 19th Cent. (PACM)* 260. *Allegory: Hope. Bohemia. Beginning of 19th Cent. (PACM)* 261.—262. *Engraved Bohemian Glasses from the first Half of the 19th Cent. (PACM)*

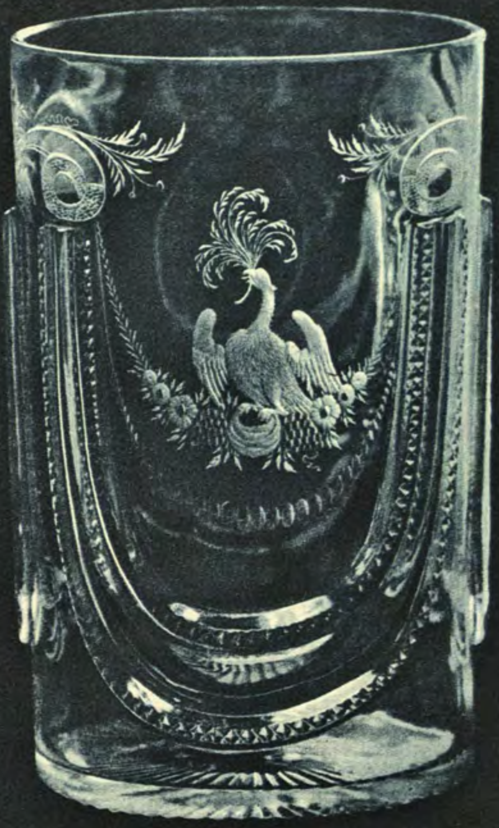


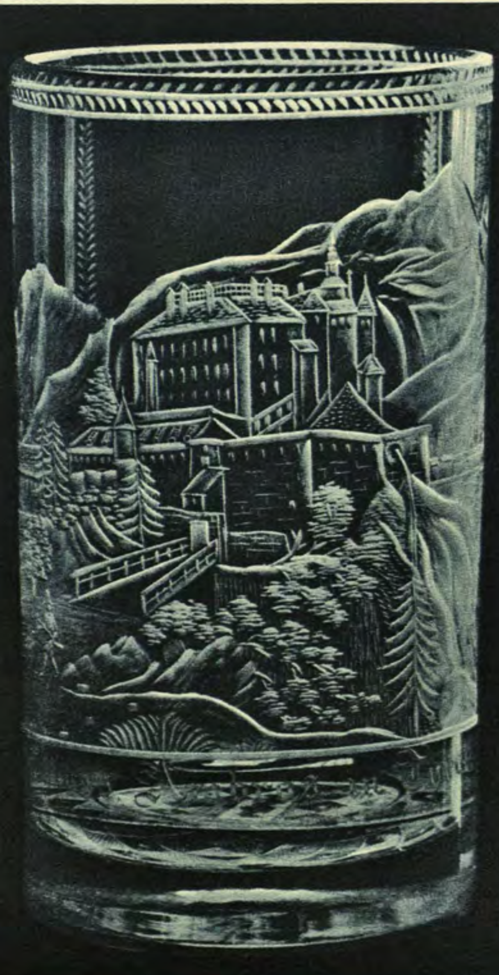
263. *Glass with Engraved Scene from Mozart's "The Magic Flute". North Bohemia, About 1820.*
Photo: J. Brok, Prague.

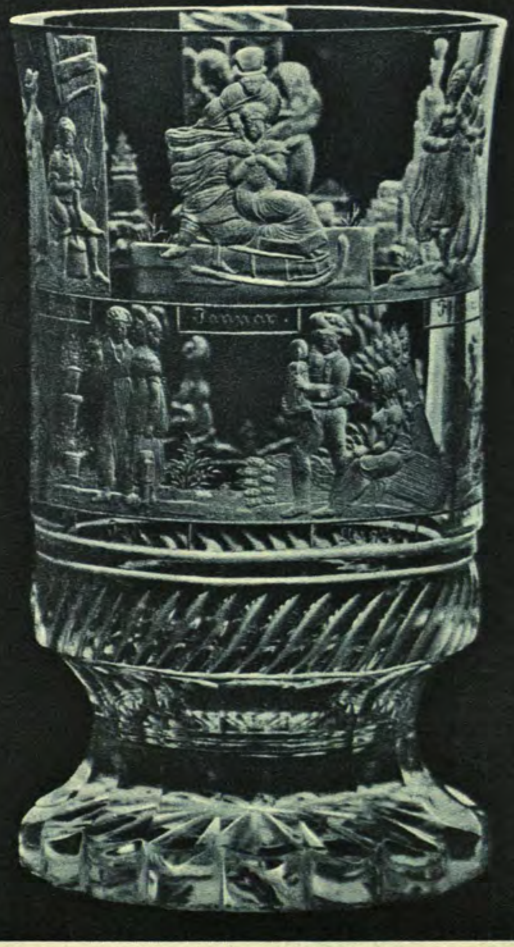


264. *Cut and Engraved Glass "Age". North Bohemia 1830.*

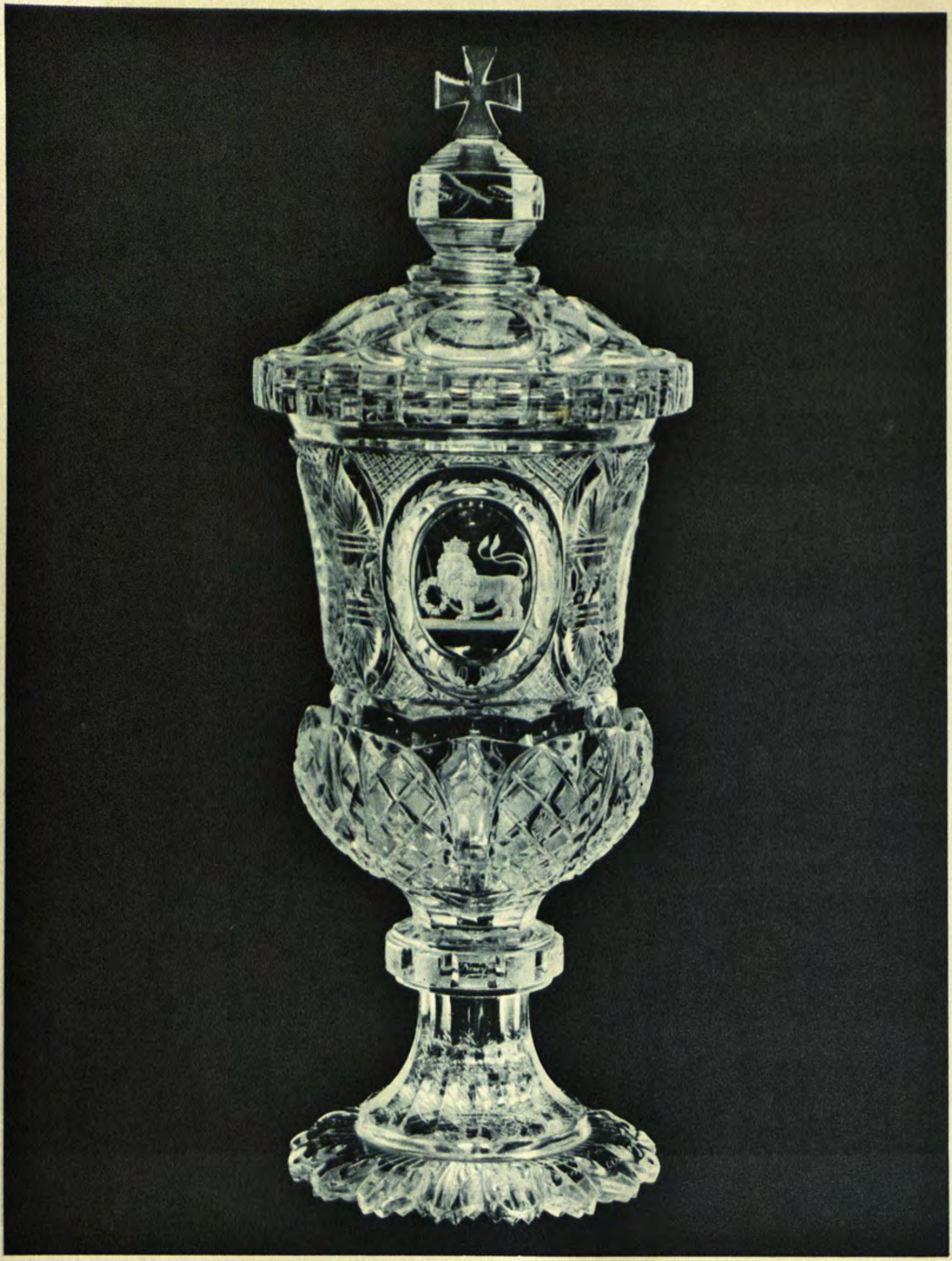




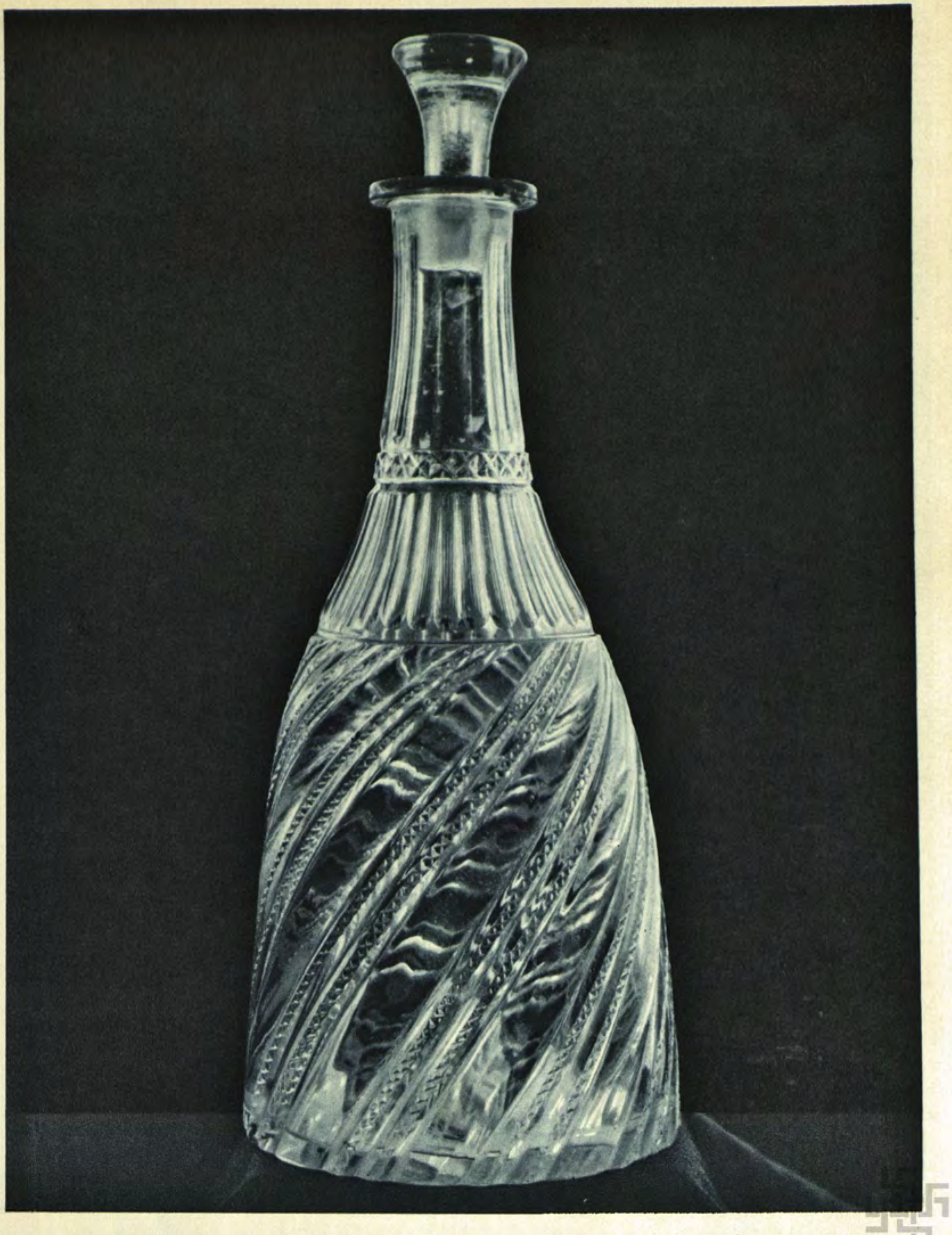




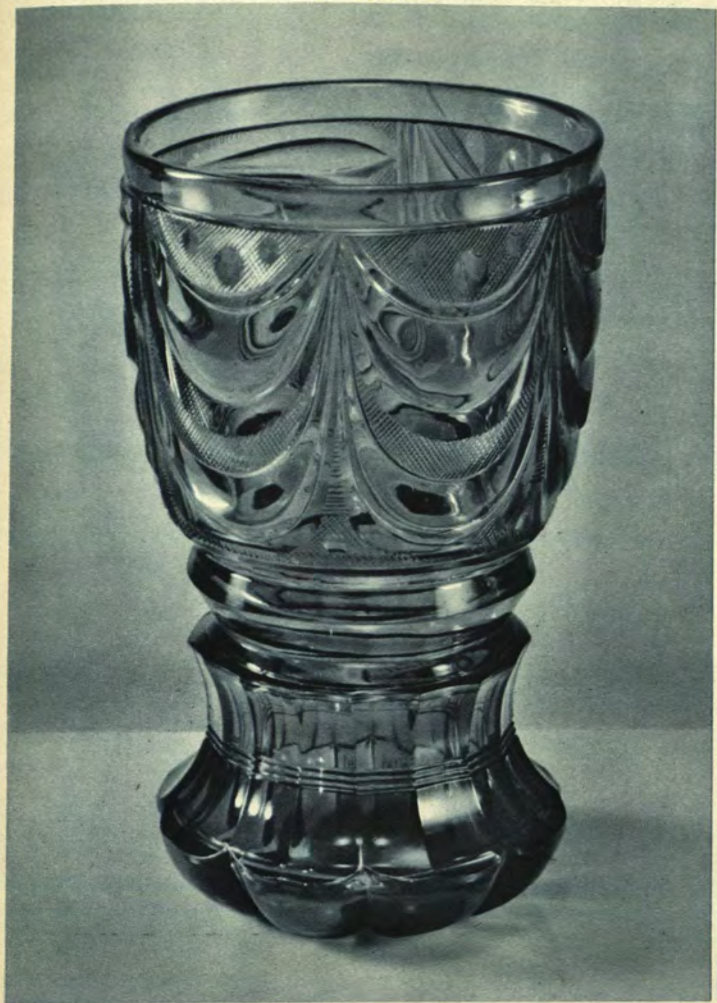
265. Cut and Engraved Glass with the Portrait of Emperor Franz I. of Bohemia, About 1806. 266. North Bohemian Engraved and Cut Glass, About 1820. 267. Castle Ambras in the Tyrol. About 1820. Engraved. 268. Anton Simm: Engraved and Cut Glass "The Seasons", Jablonec, About 1830.

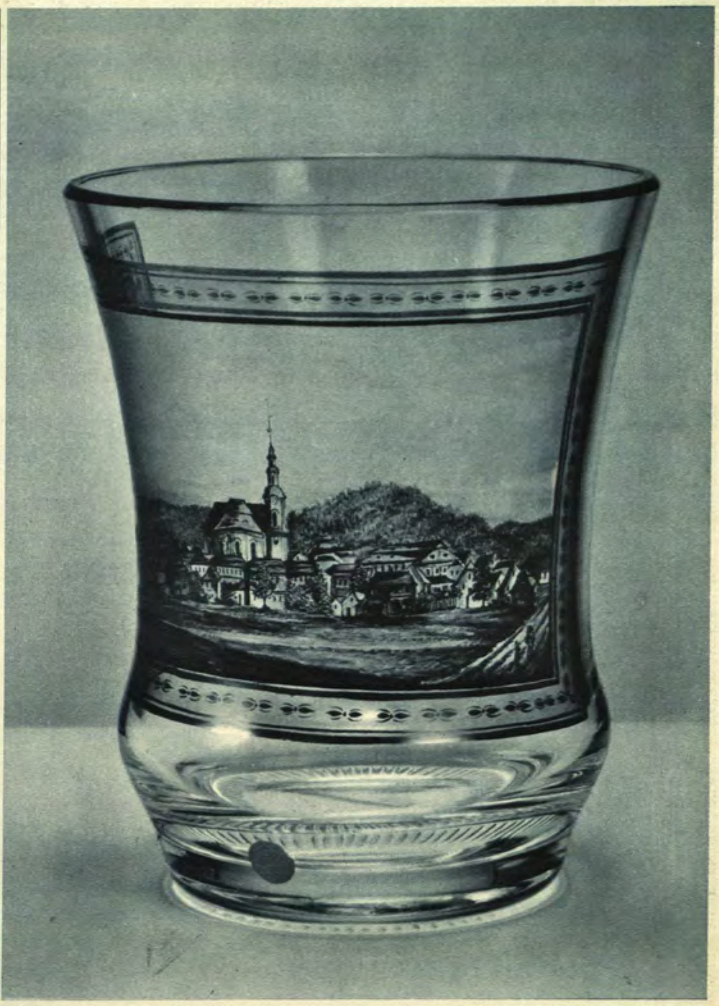


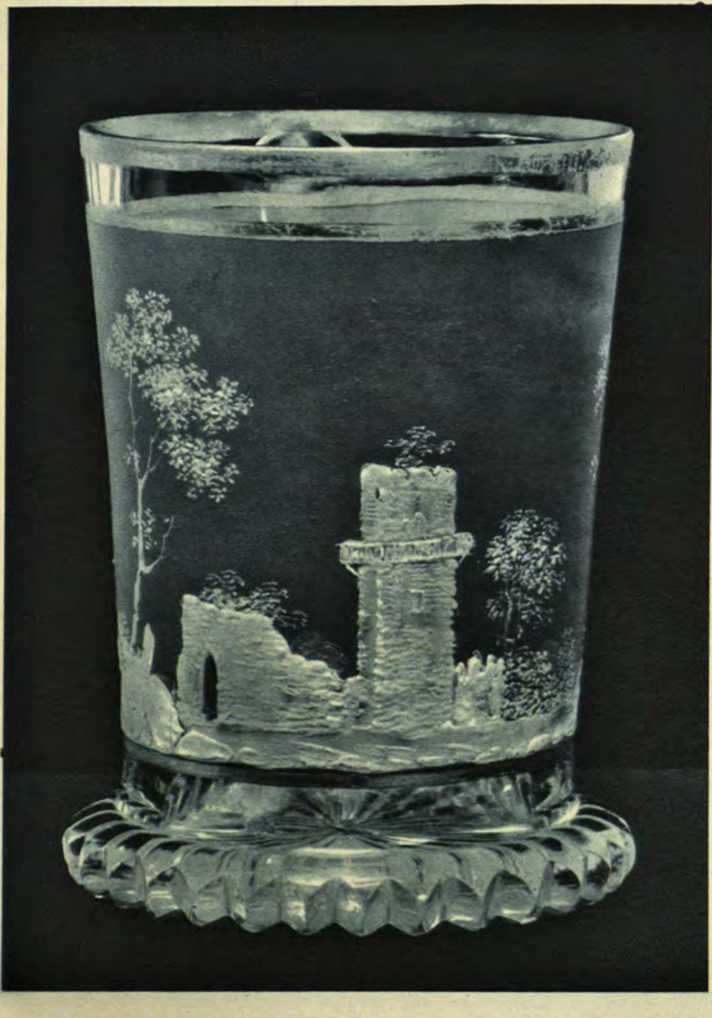
269. *Vessel with Lid, Cut and Engraved, with the Inscription: Joseph Jungmann, Nový Svět, signed "Pešina". 1832. Private Collection. Photo: J. Brok, Prague*

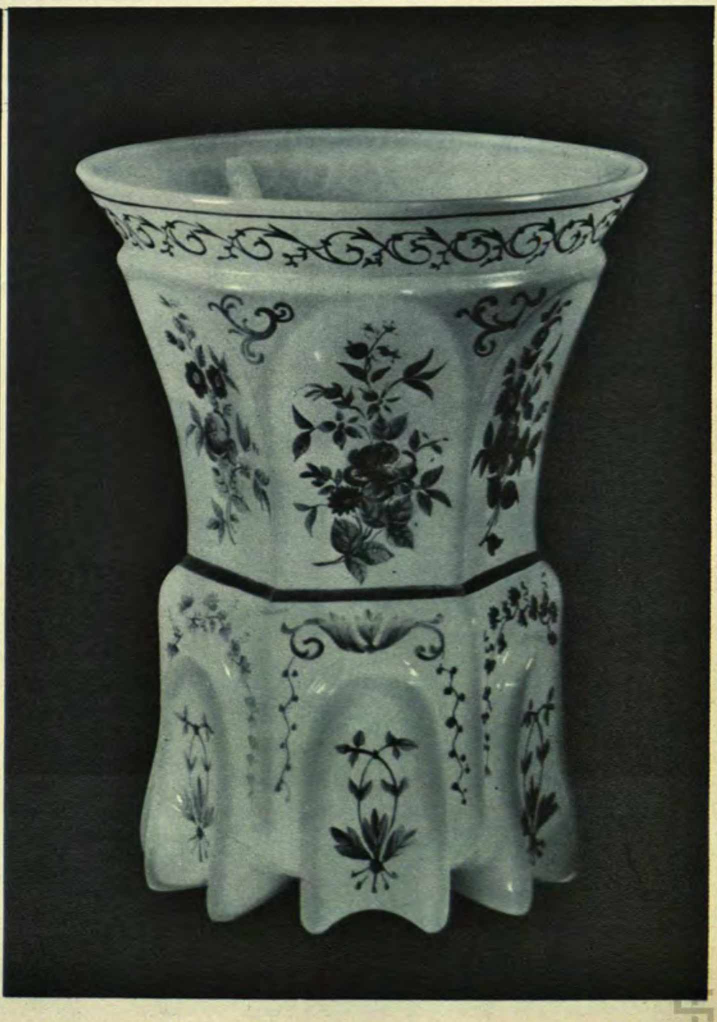


270. *Bohemian Cut Carafe, Beginning of 19th Century. (PACM) Photo: J. Brok, Prague*

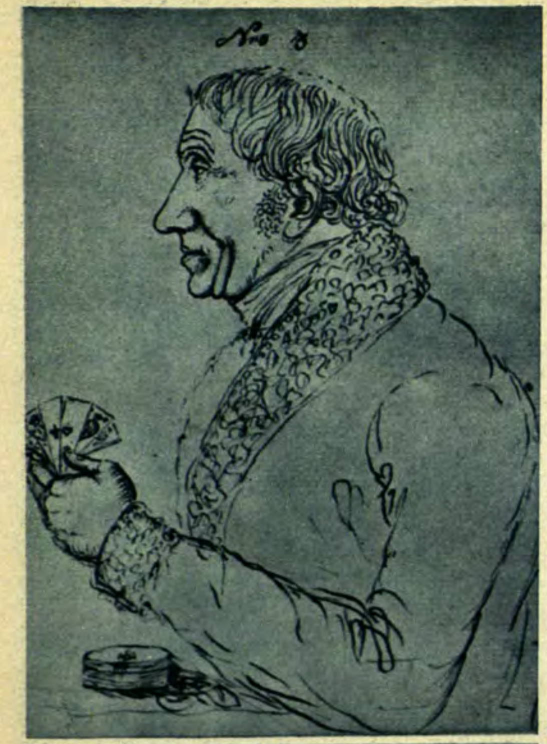


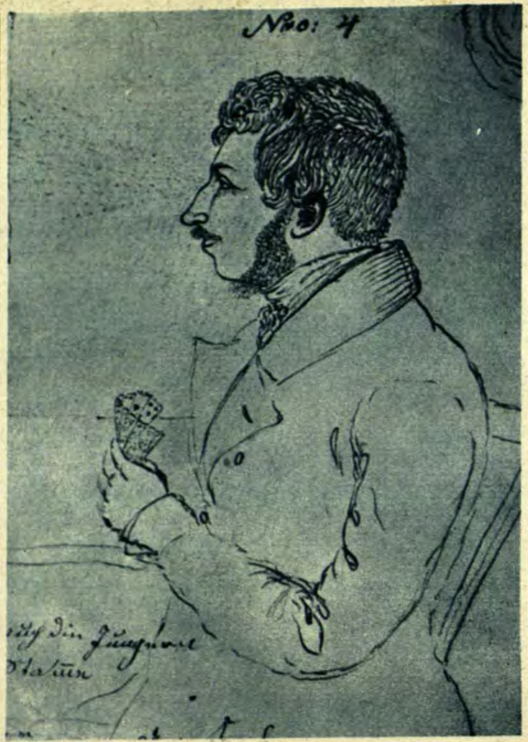


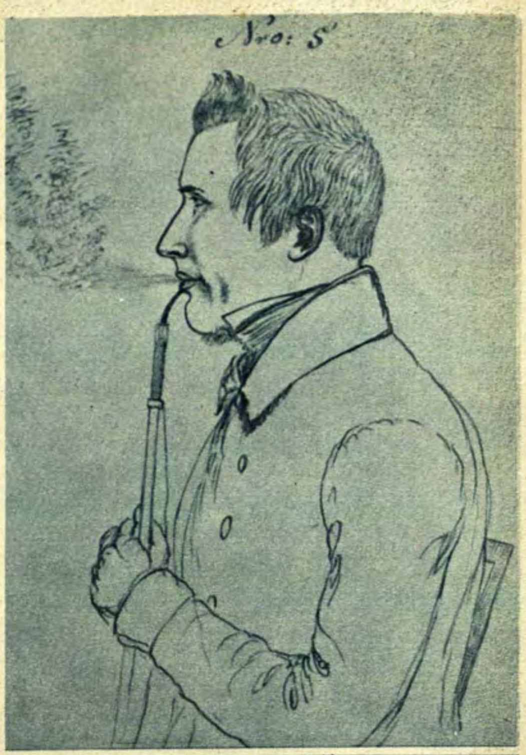


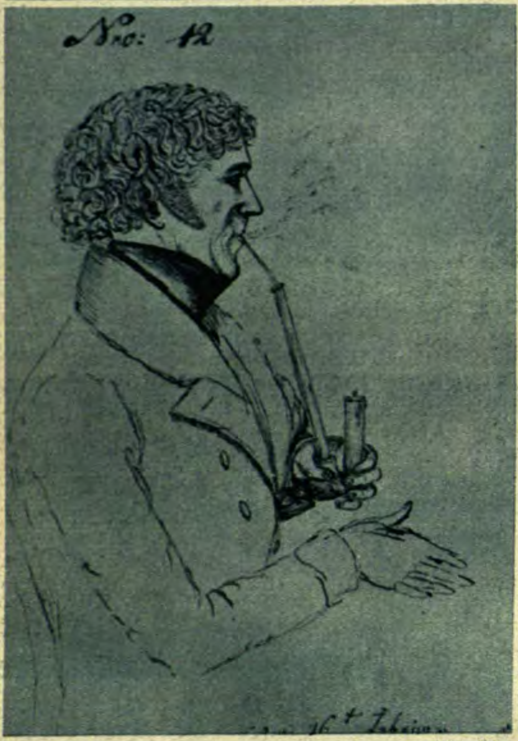


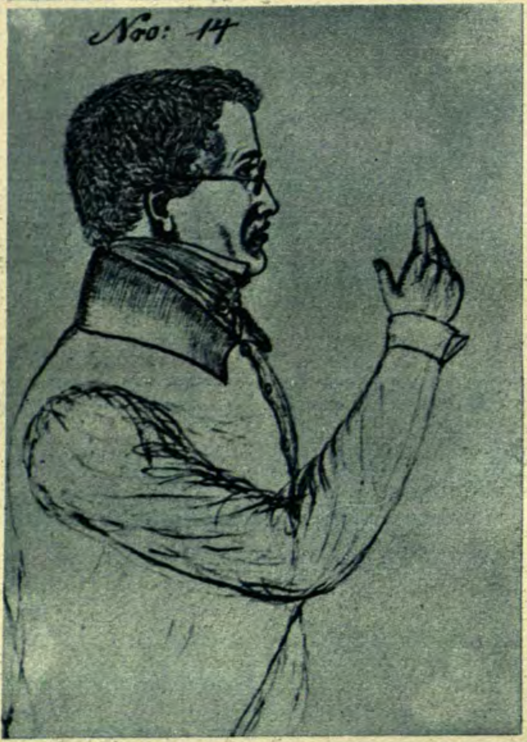
271. Glass Made of Ruby-Glass, Cut. Bohemia, About 1830. (PACM) Photo: J. Brok, Prague. 272. Glass Painted with Transparent Enamel. Haida, Bohemia, First Quarter of 19th Century. (PACM) Photo: J. Brok, Prague. 273. F. Egermann: Beaker with a Decoration in White Enamel, Relief. Blottendorf. First Quarter of 19th Century. (PACM) Photo: J. Brok, Prague. 274. Glass of White Opal, with Coloured Flower Painting. Bohemia, About 1840. (PACM) Photo: J. Brok, Prague.

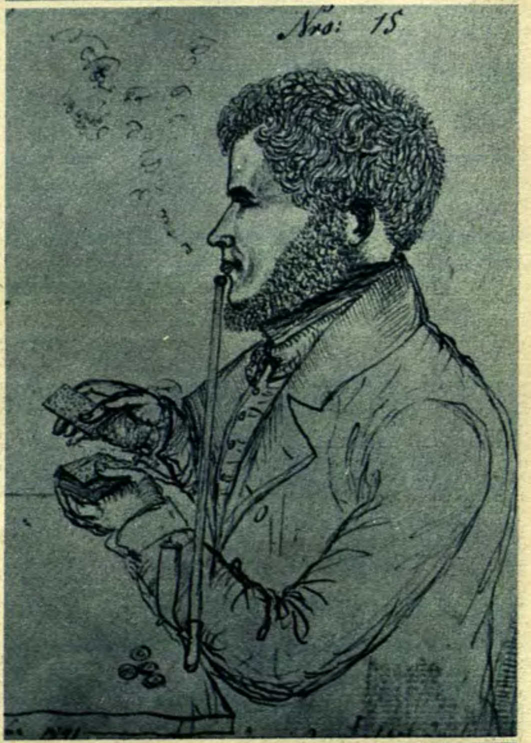


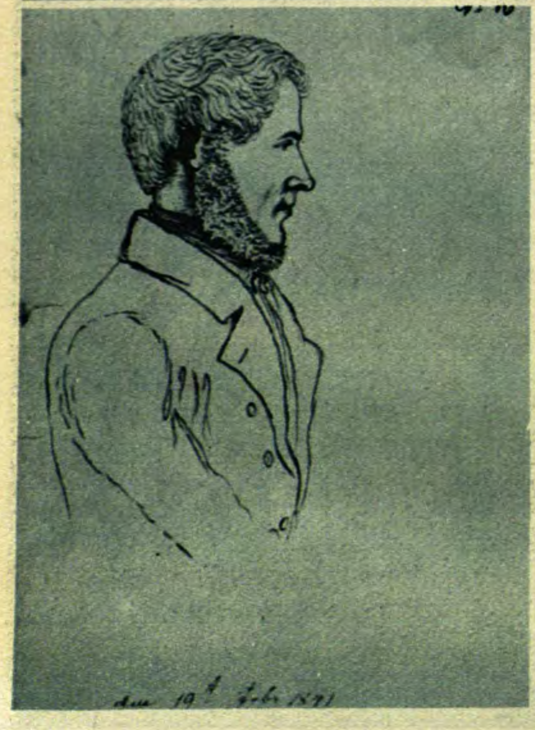


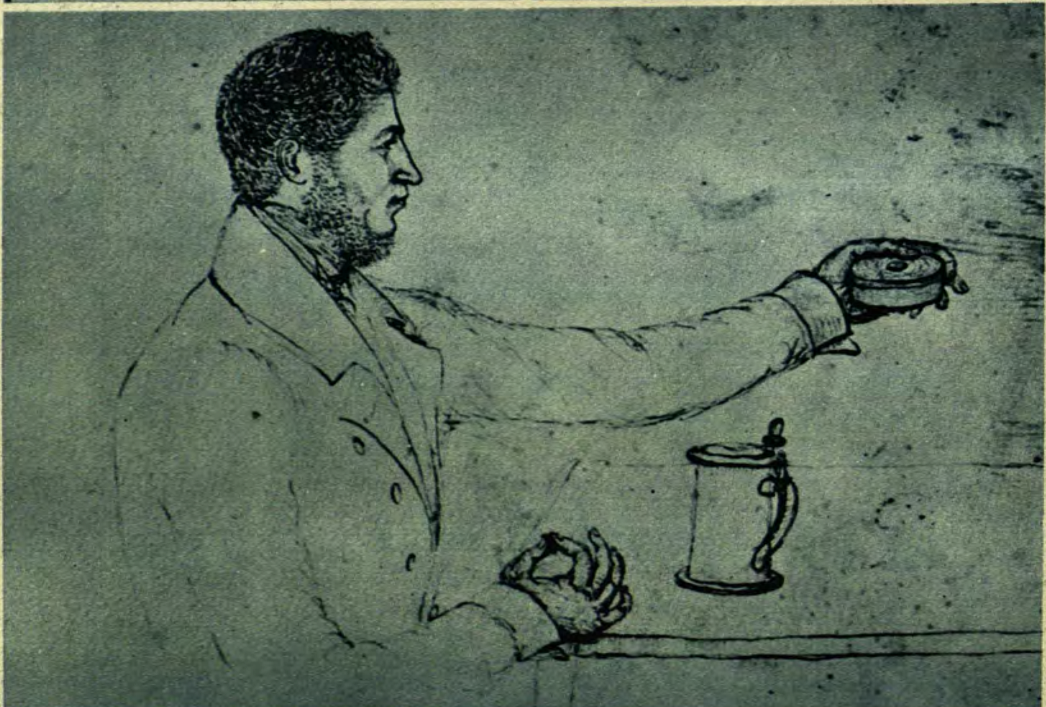




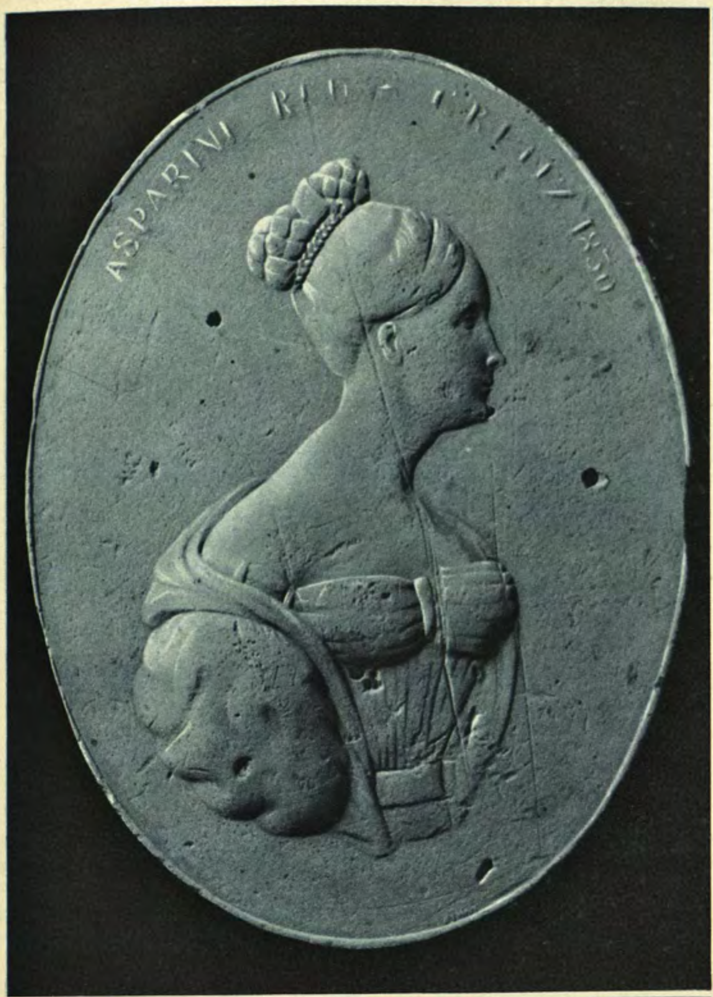


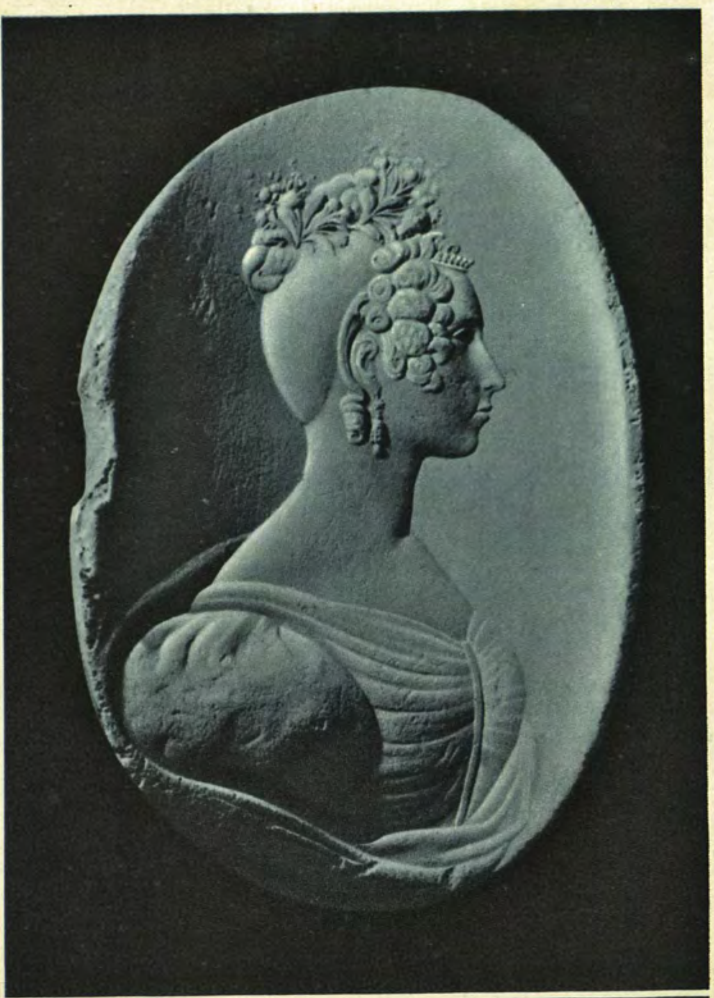


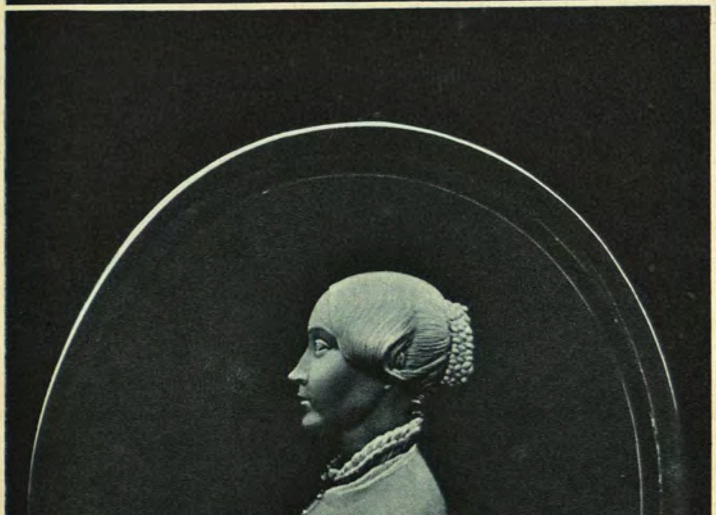


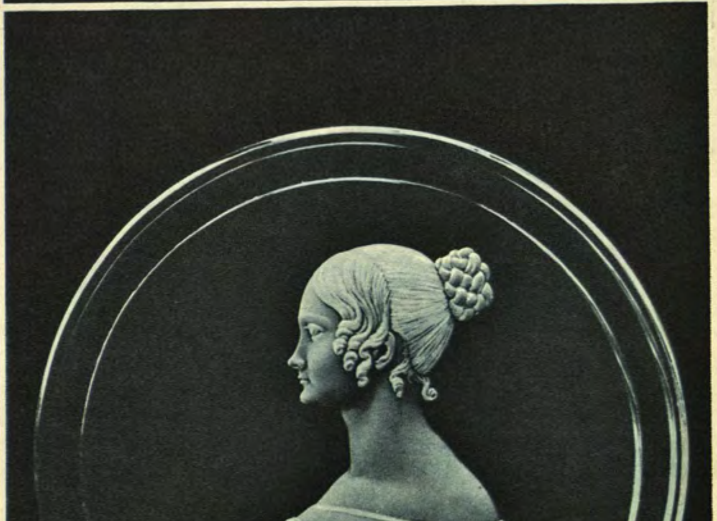


275.—282. *Dominicus Biman: Portrait Sketches.*

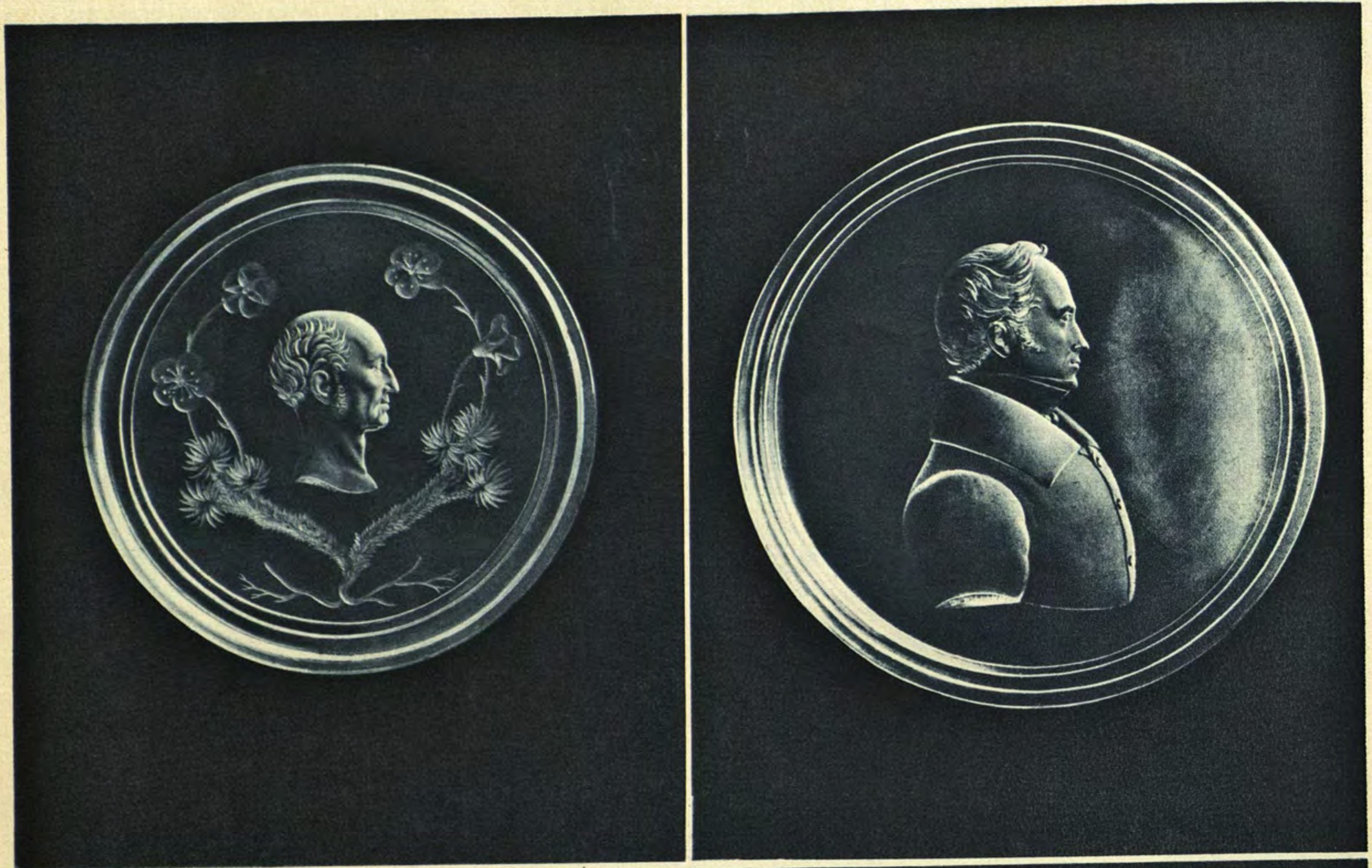


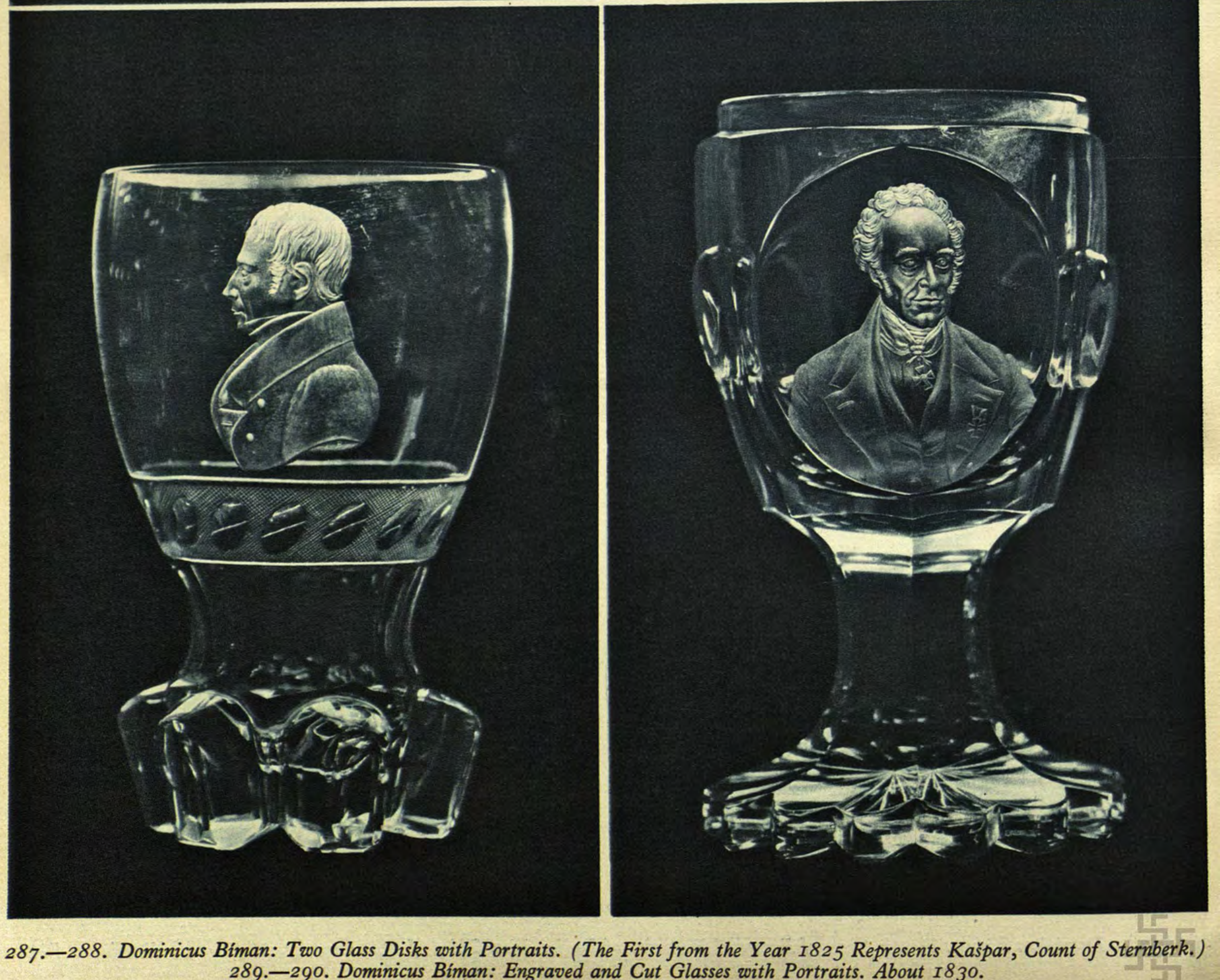




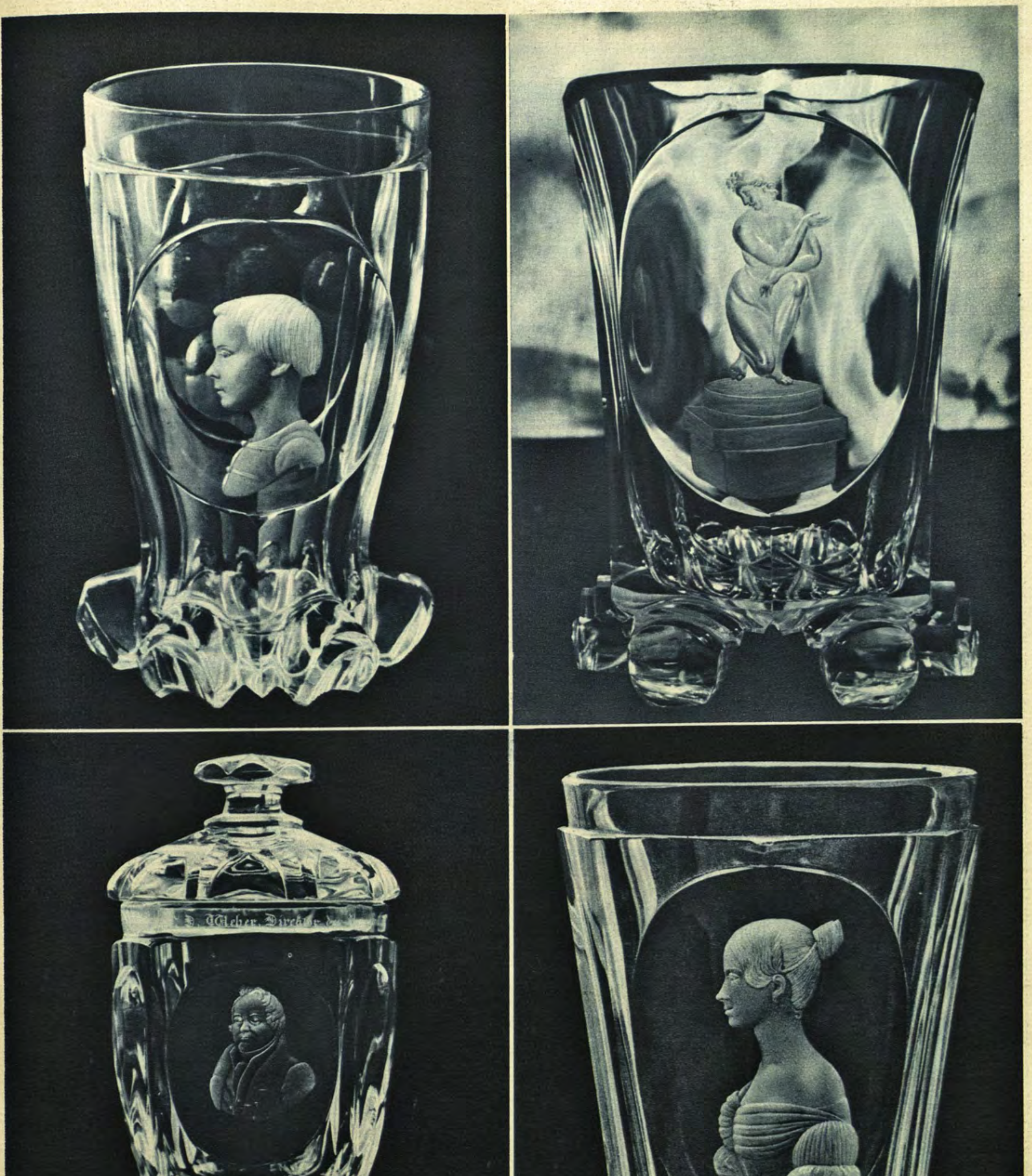


283.—284. Dominicus Bíman: Plaster Casts of Engraved Portraits of Ladies. First Third of 19th Century. 285.—286. Dominicus Bíman: Two Portraits of Ladies. About 1835.

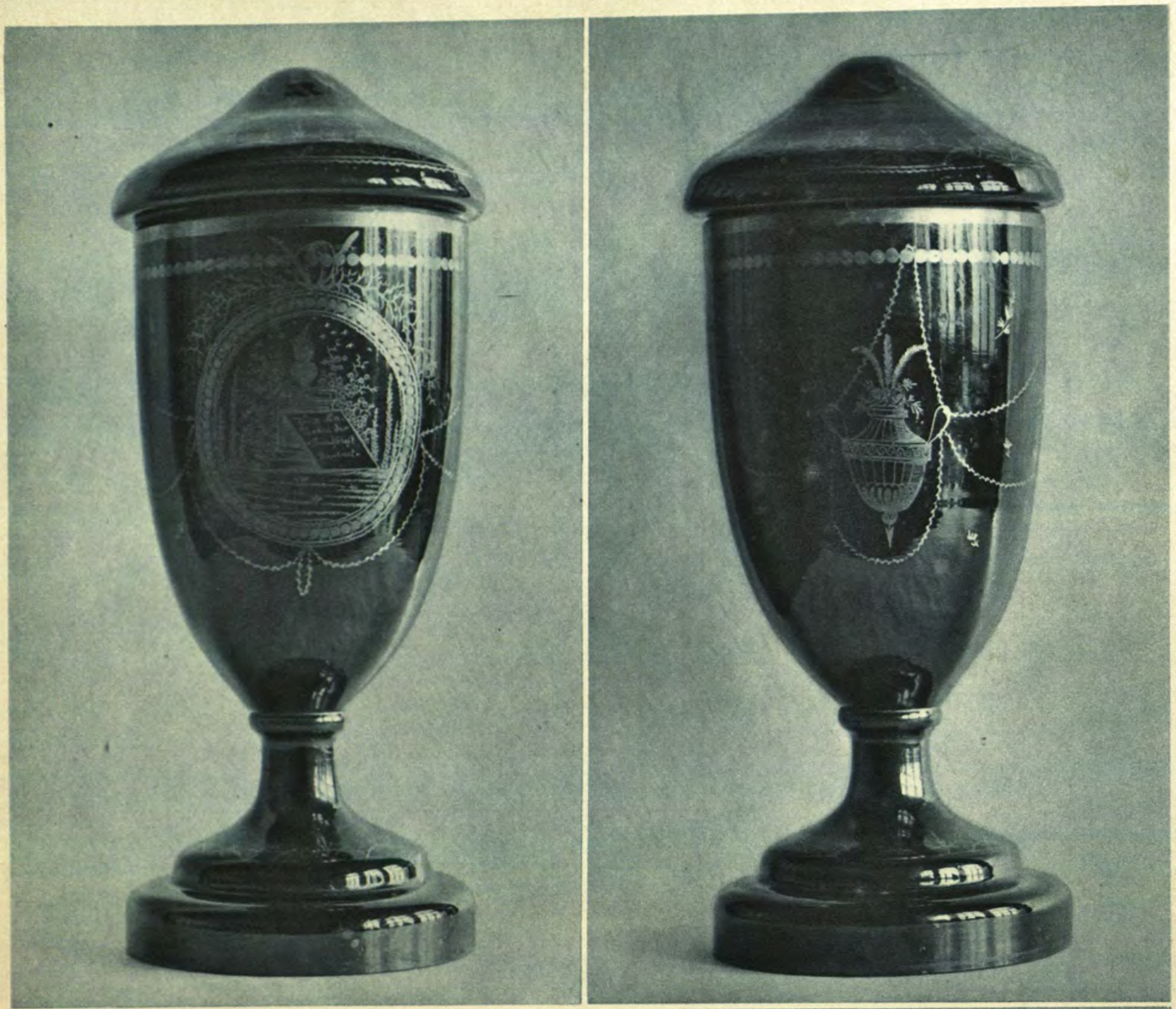




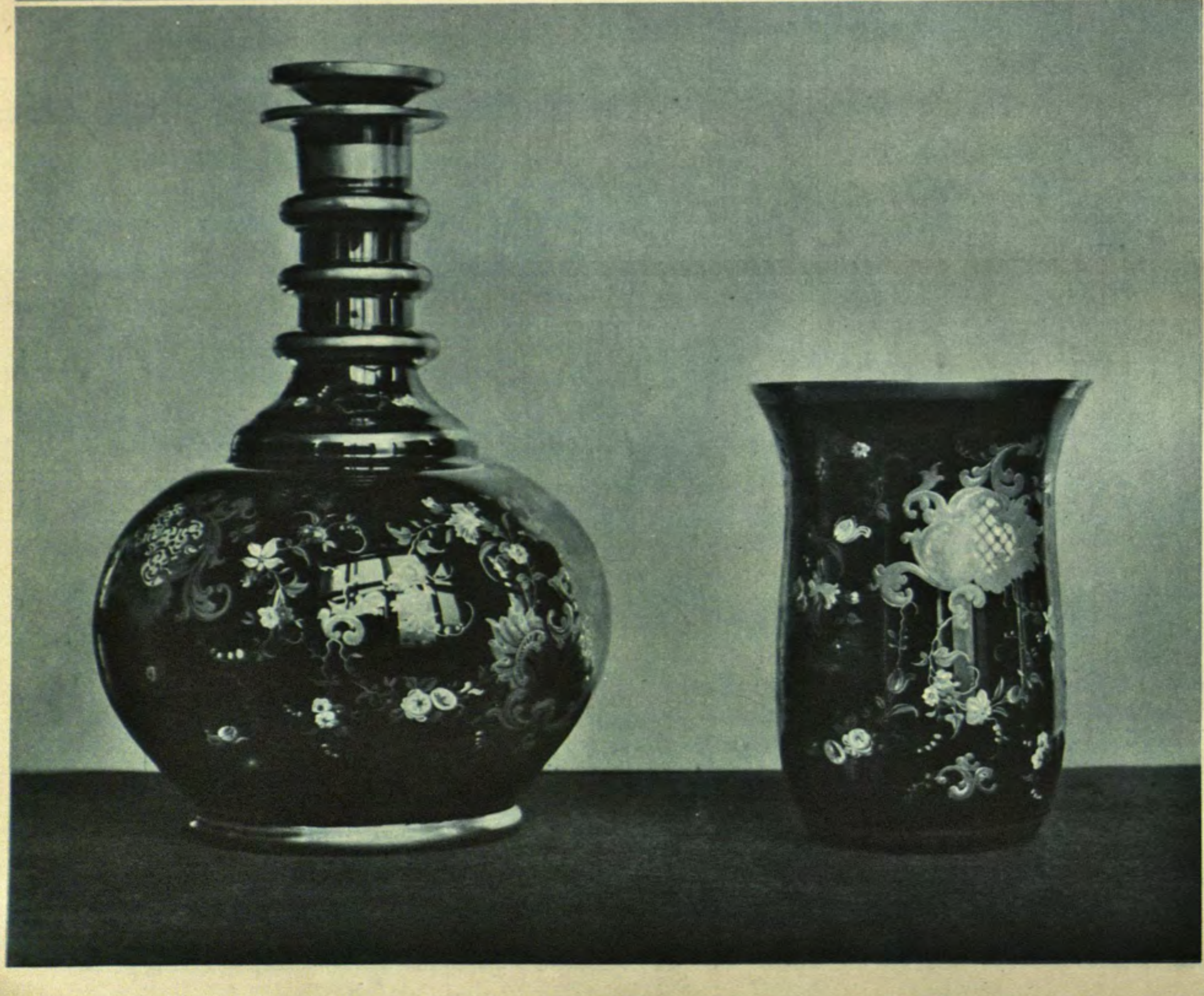
287.—288. Dominicus Biman: Two Glass Disks with Portraits. (The First from the Year 1825 Represents Kašpar, Count of Sternberk.)
289.—290. Dominicus Biman: Engraved and Cut Glasses with Portraits. About 1830.



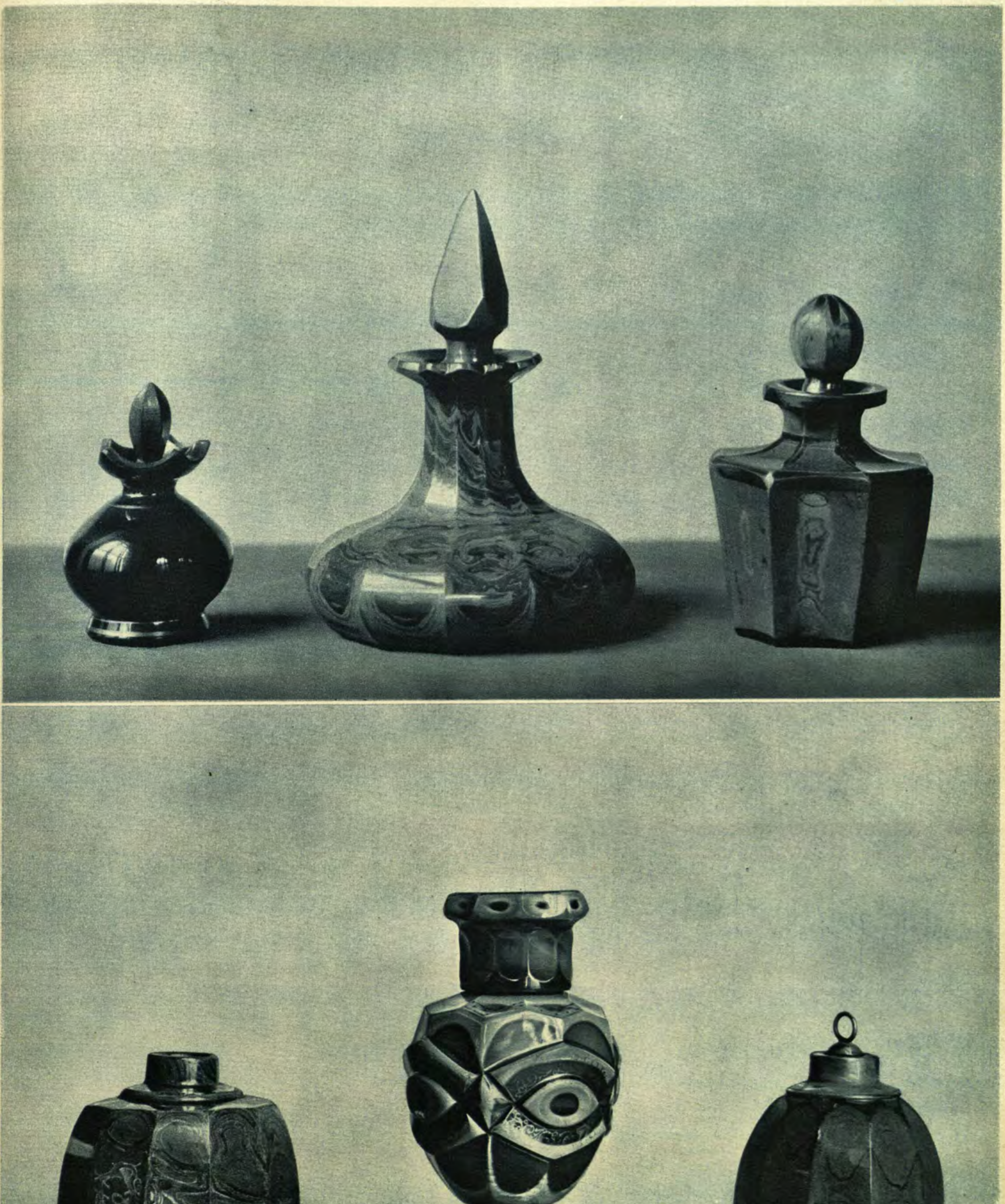
291.—294. Dominicus Biman: Engraved and Cut Glasses. About 1830.



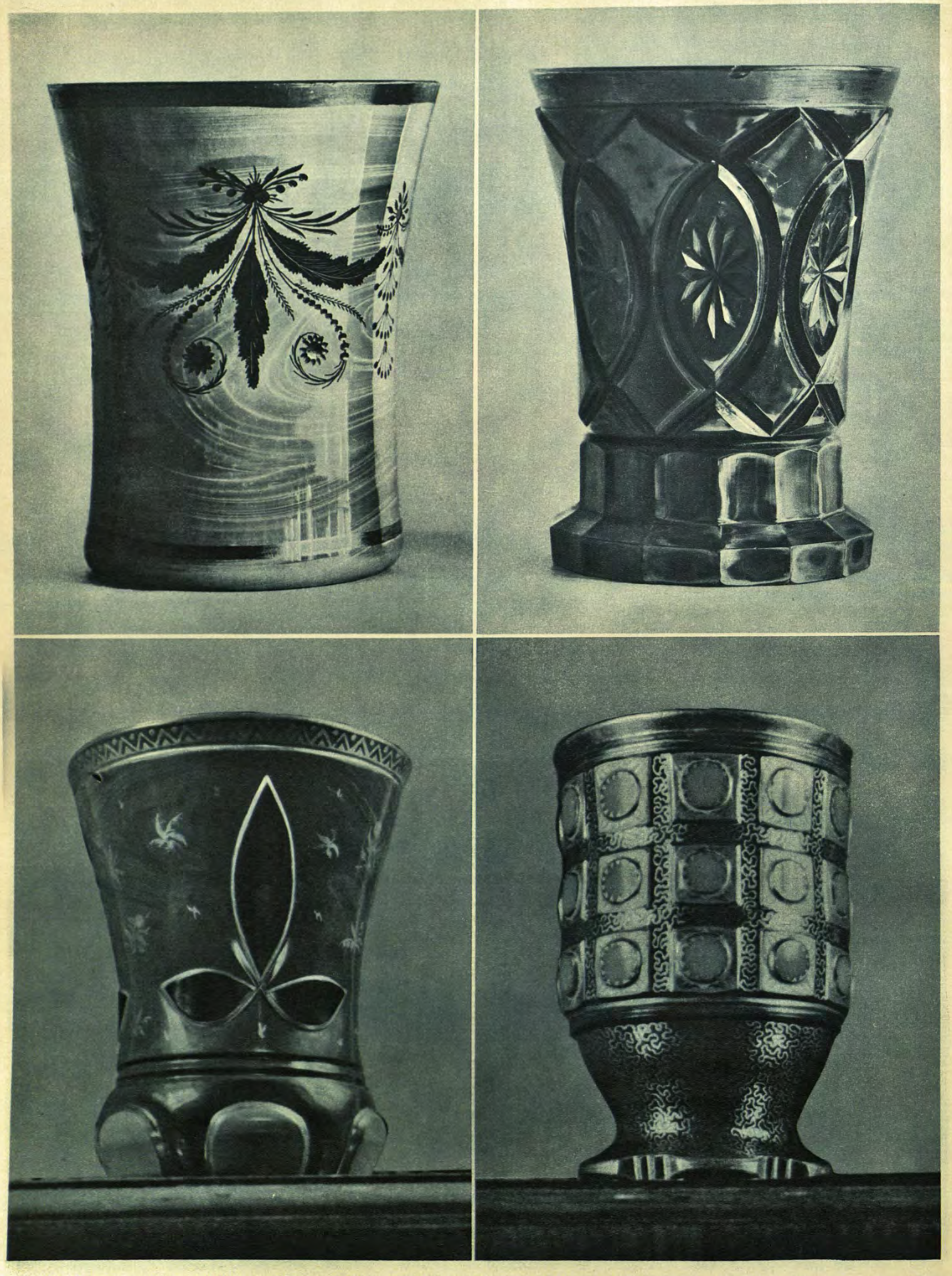
295.—296. Hyalith Urns made at the Buquoy Glass-House. 1820. City Museum, Prague.



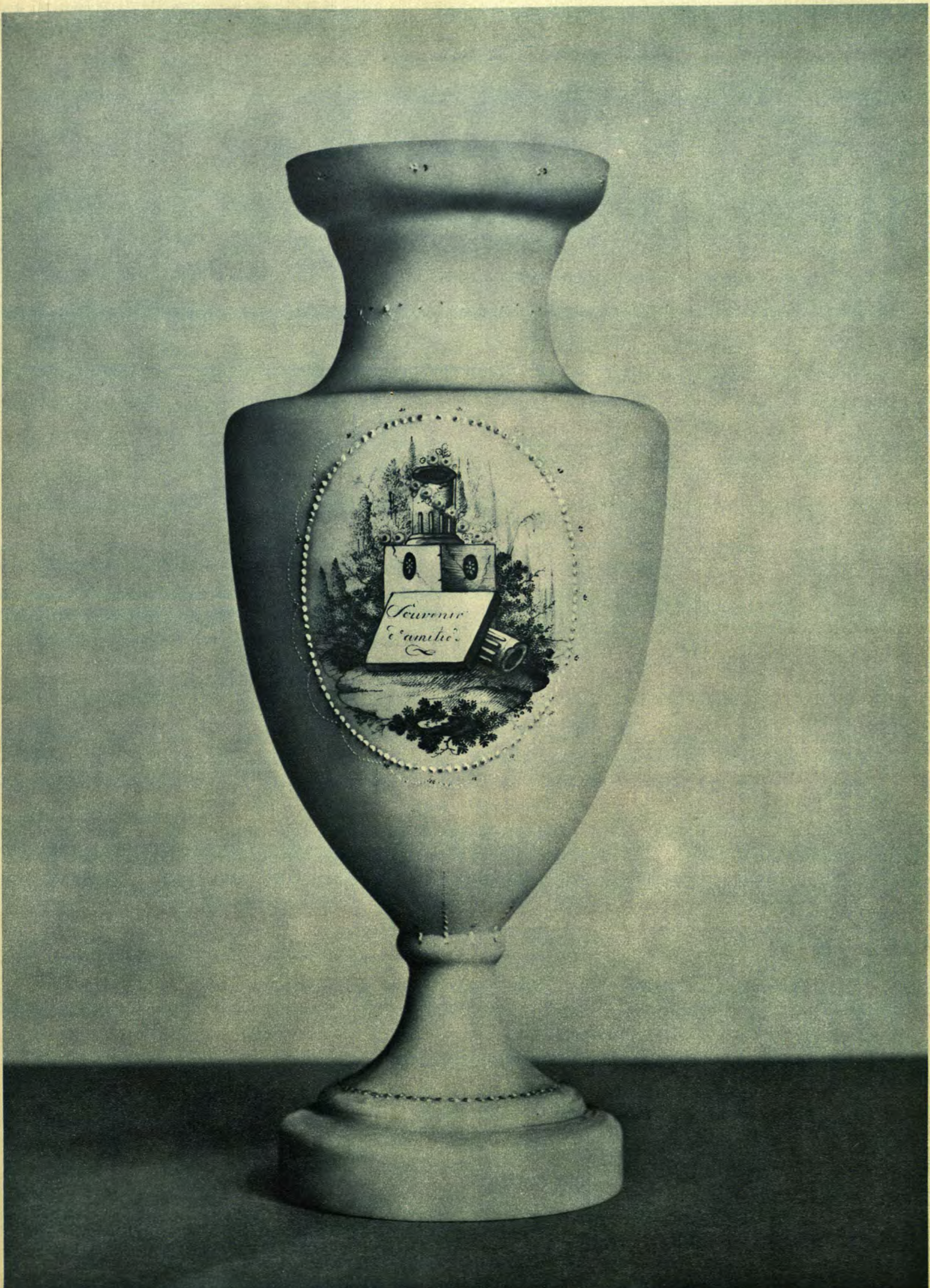
297. Hyalith Vases and Beaker. Bohemia, 19th Cent. (PACM)



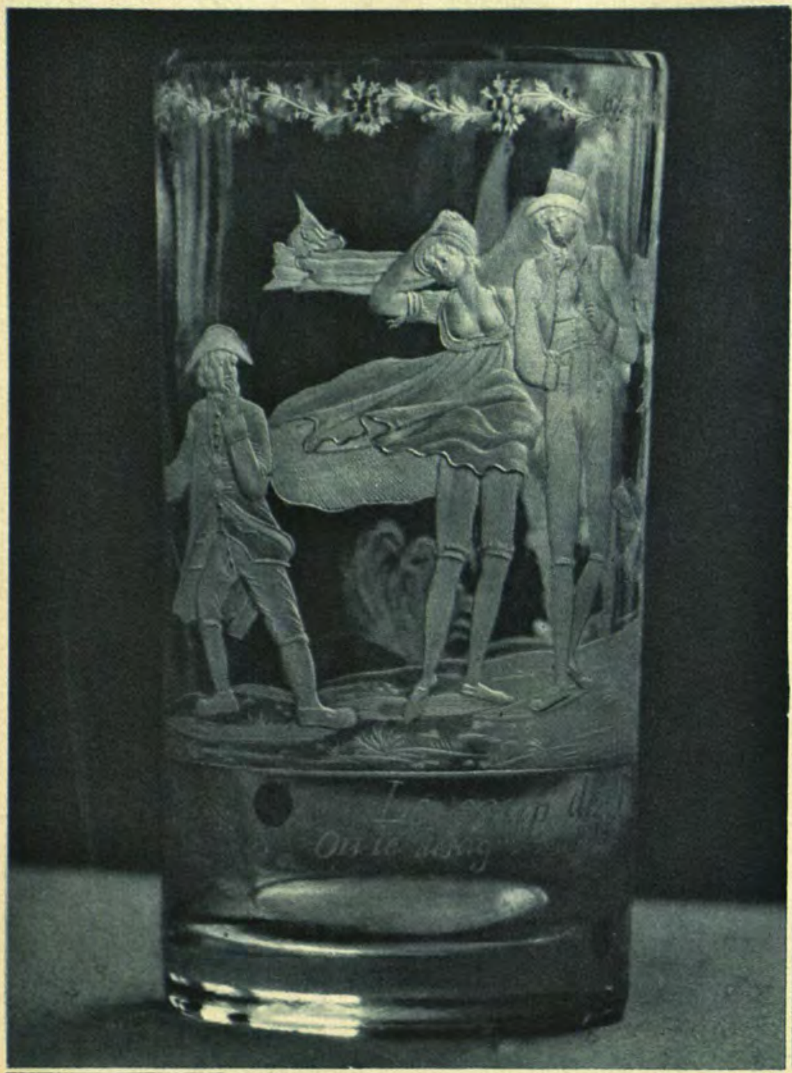
298. Fr. Egermann: Cut-Glass Flacons Made of Opaque Lithyalin. Beginning of 19th Cent. Nový Bor. (PACM)

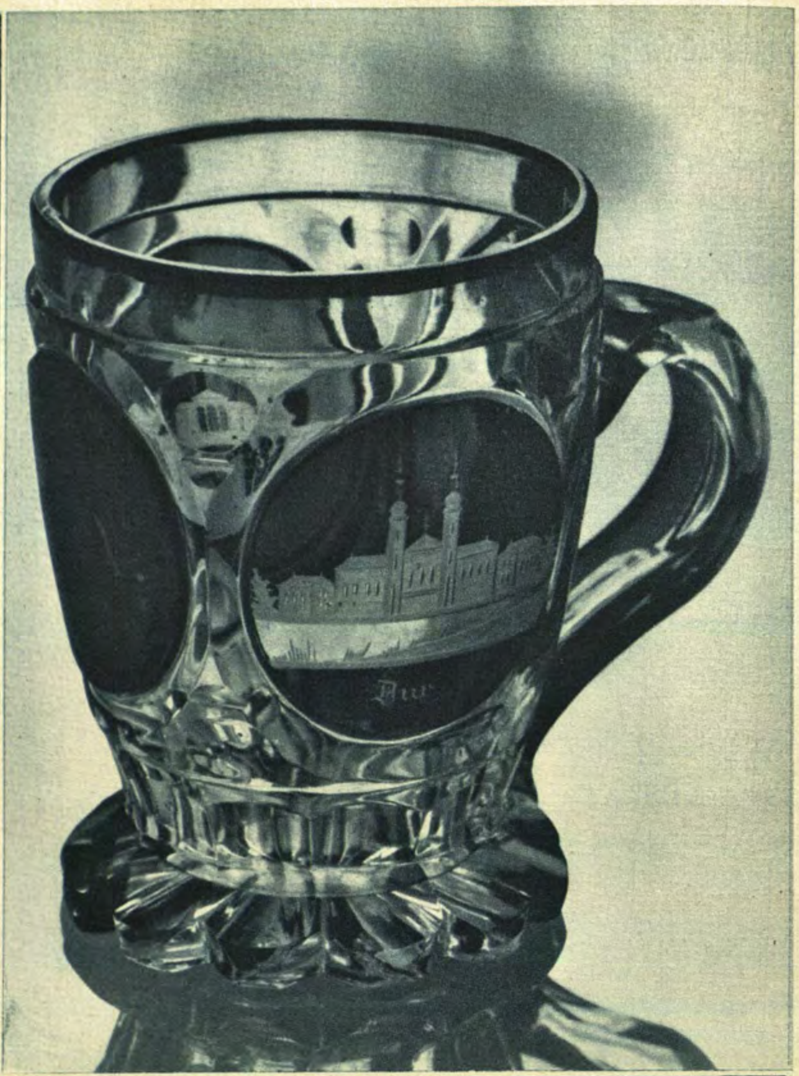


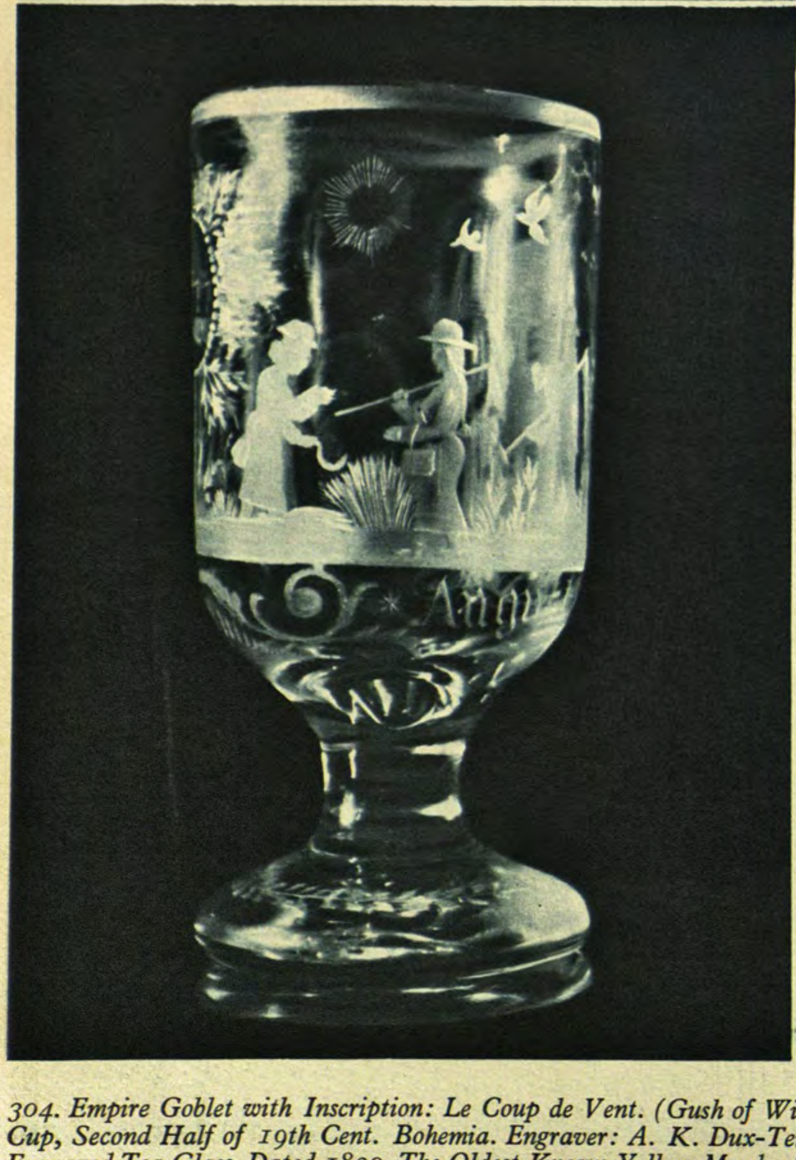
299. Fr. Egermann: Glass of Opaque, Engraved Lithyalin. About 1830. City Museum, Prague. 300. Cut Lithyalin. About 1830. City Museum, Prague. 301. Fr. Egermann: Transparent Lithyalin-Glass, in Four Colours, Cut, Gilded. Nový Bor. From the Property Left by Egermann. 302. Fr. Egermann: Richly Gilded, Multi-Coloured, Semi-Transparent Lithyalin-Glass. Cut. (Left by Egermann.)

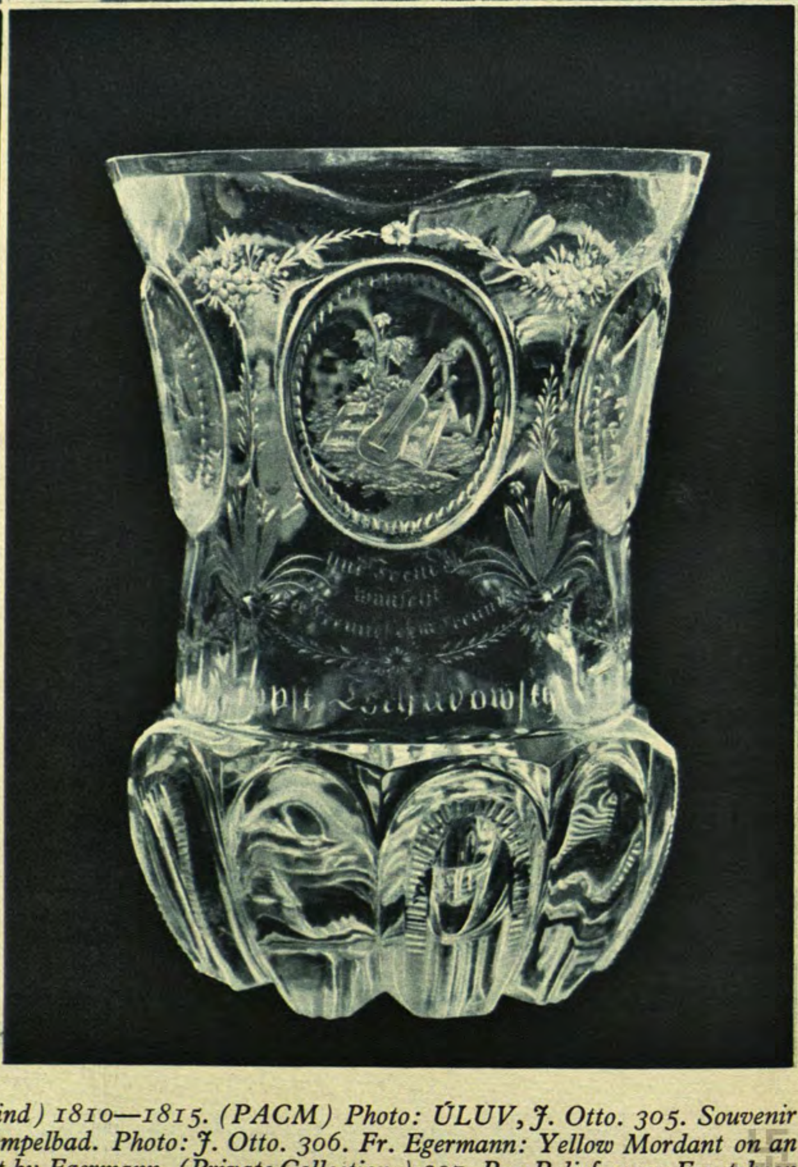


303. Fr. Egermann: Vase of Dull Bone-Glass with Black-Enamelled Still-Life. Beginning of 19th Century. Nový Bor.



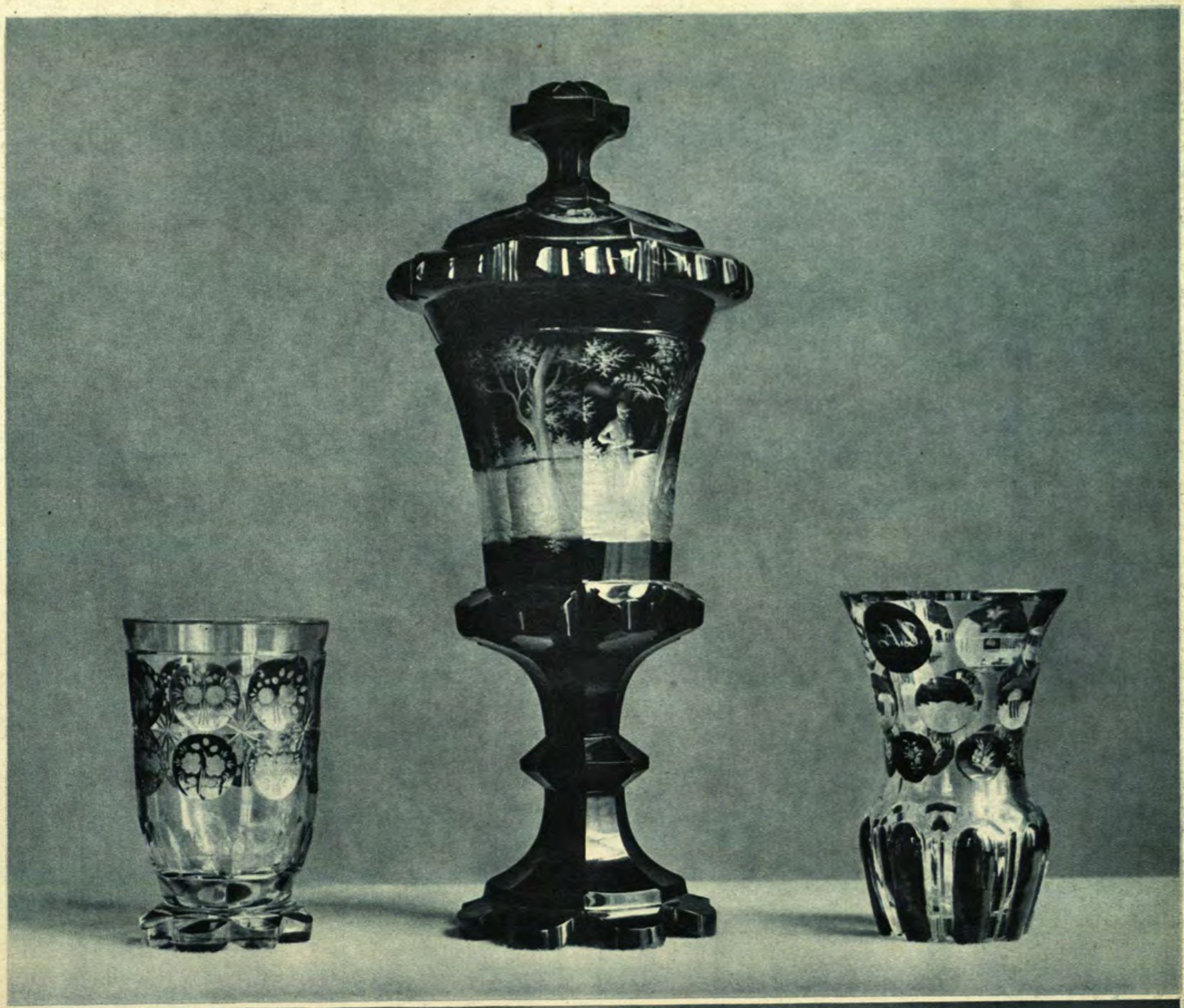


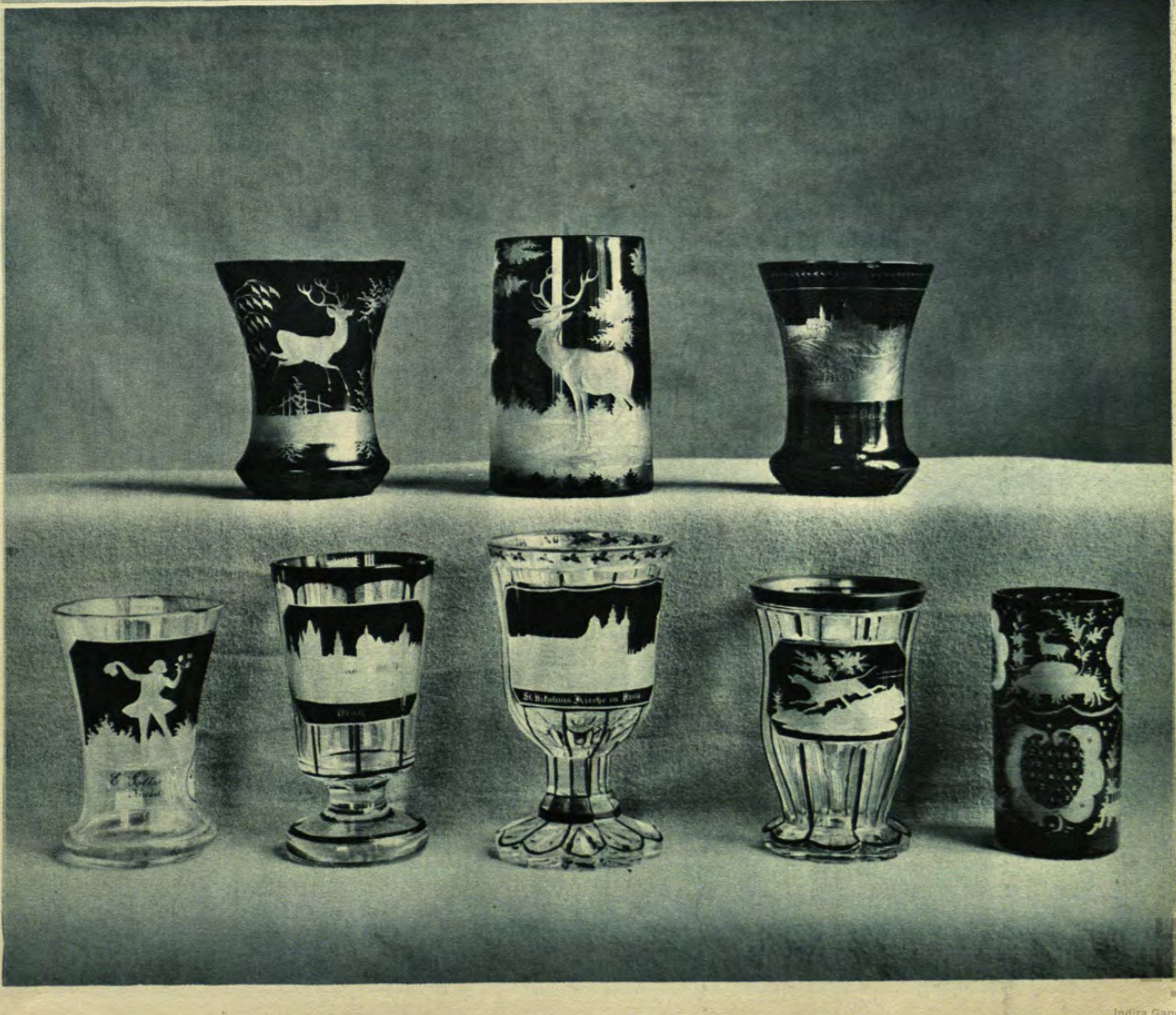




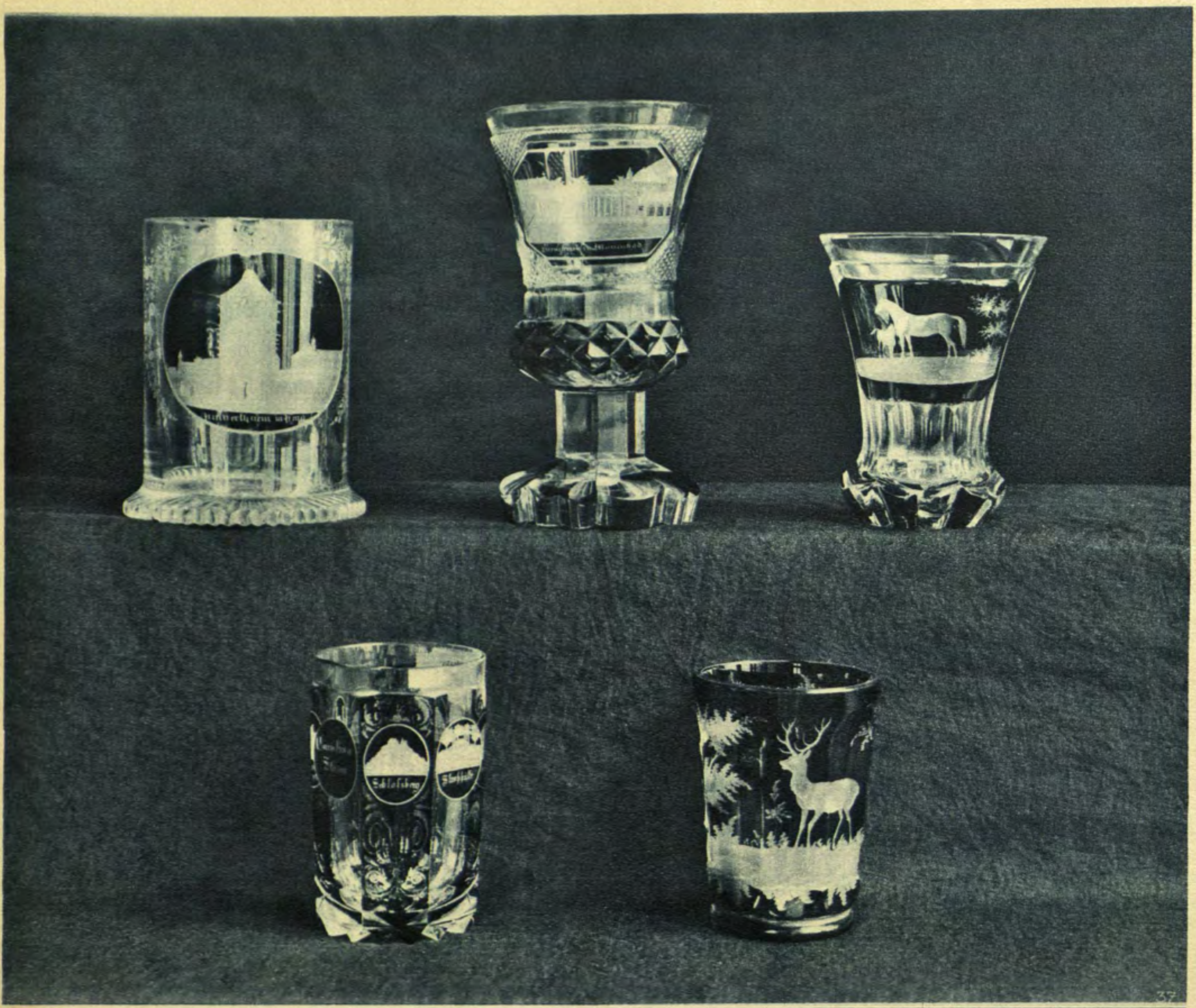
304. Empire Goblet with Inscription: Le Coup de Vent. (Gush of Wind) 1810—1815. (PACM) Photo: ÚLUV, J. Otto. 305. Souvenir Cup, Second Half of 19th Cent. Bohemia. Engraver: A. K. Dux-Tempelbad. Photo: J. Otto. 306. Fr. Egermann: Yellow Mordant on an Engraved Tea Glass, Dated 1820. The Oldest Known Yellow Mordant by Egermann. (Private Collection.) 307. Bas-Relief on an Escutcheon Glass. Bohemia. First Half of 19th Cent. (PACM)

308. Goblet and Glass, Cut, Engraved, with a Colour Mordant. Bohemia, First Half of 19th Cent. (PACM)

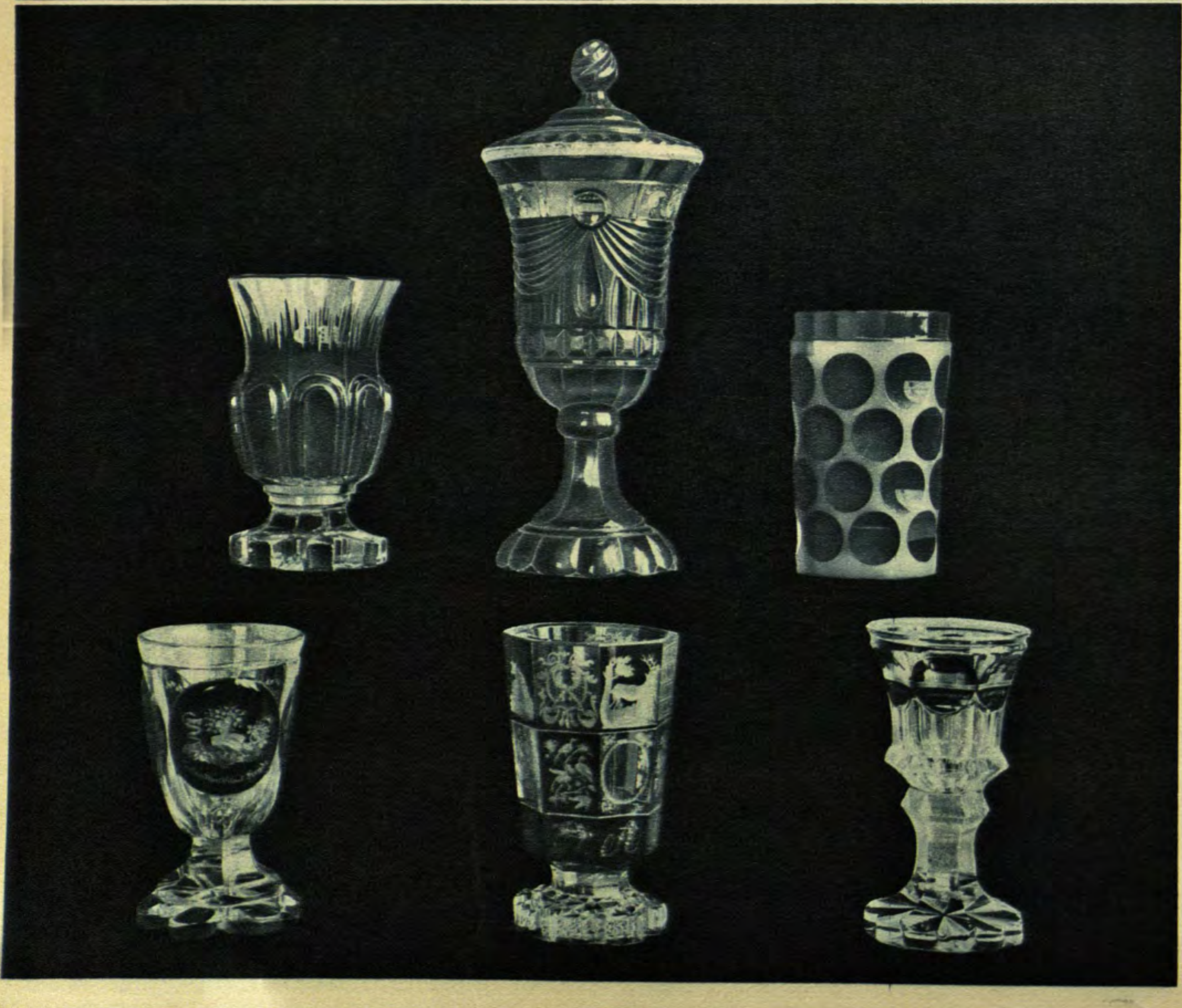




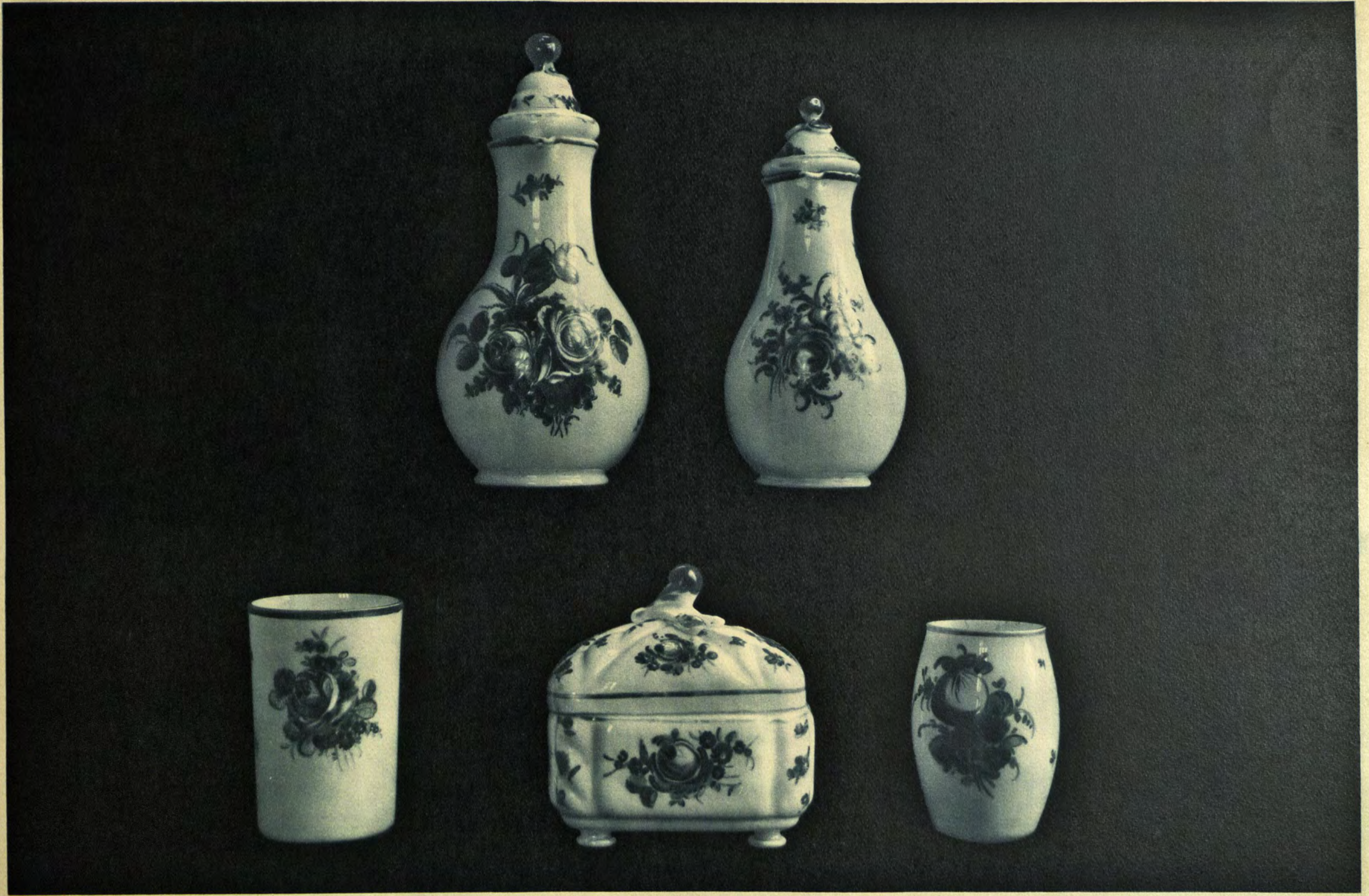
309. Cut, Engraved Glasses with Ruby Decorations. Bohemia, First Half of 19th Cent. (PACM)



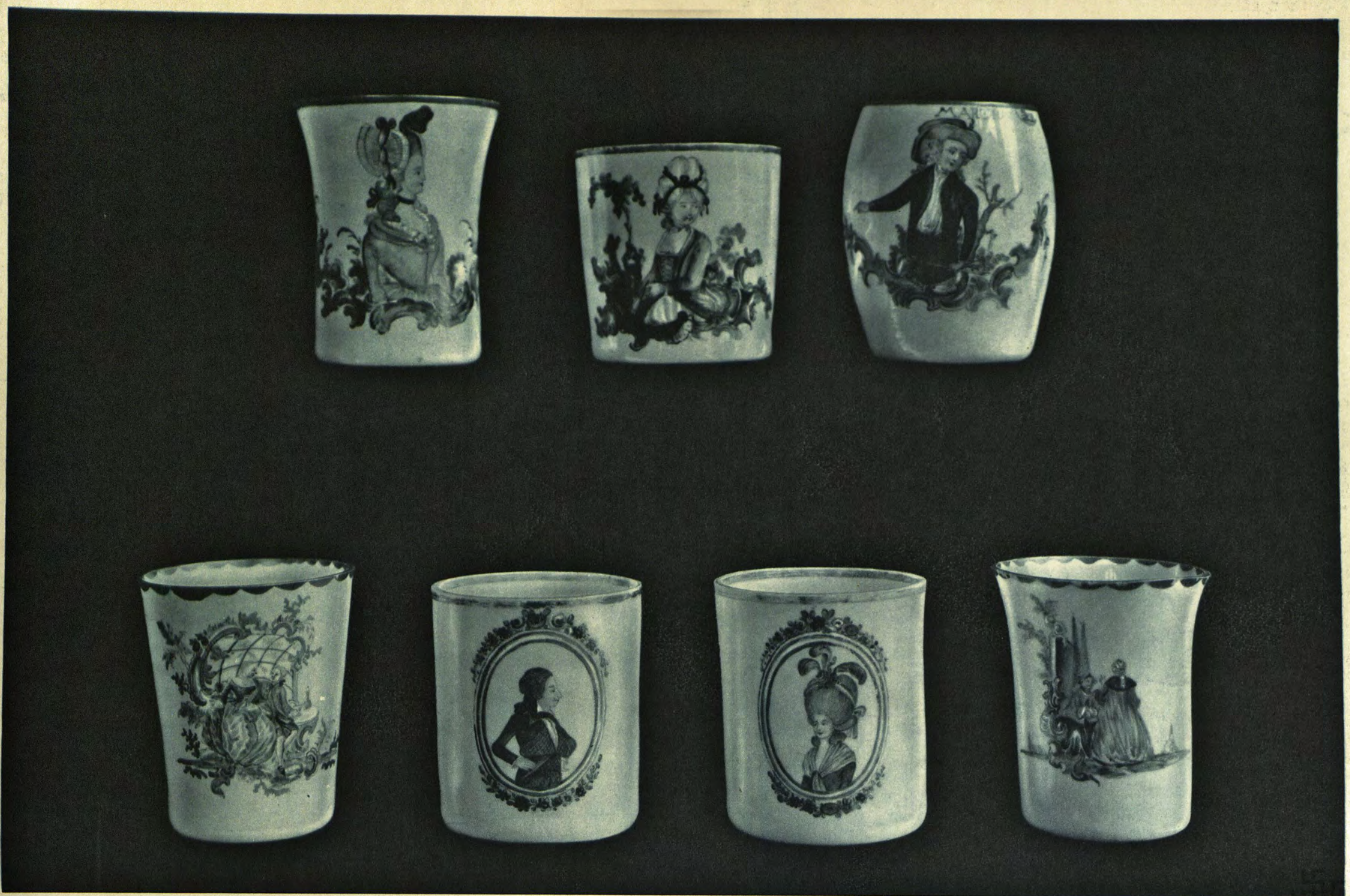
310. Cut, Engraved Glasses with a Colour Mordant. Bohemia, First Half of 19th Cent. (PACM.)



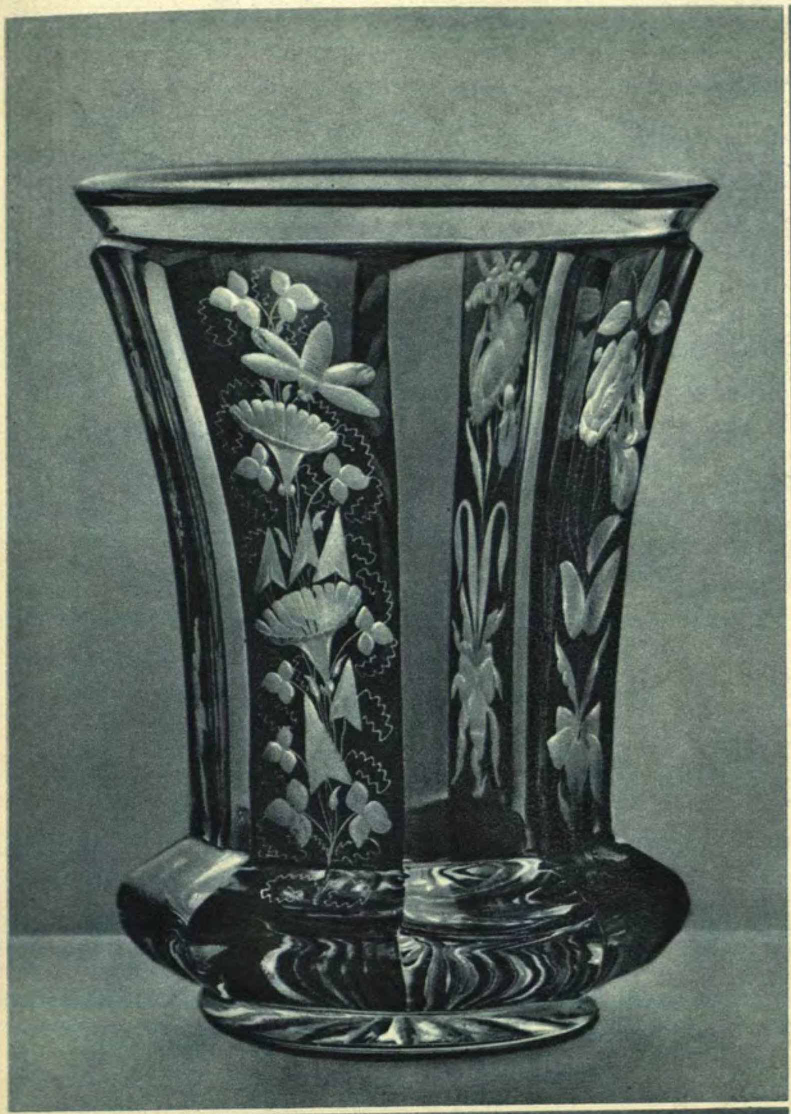
311. Goblet and Glass, Overlaid with Coloured, Transparent Glass, Cut, Engraved, Etched. First Half of 19th Cent. (PACM)

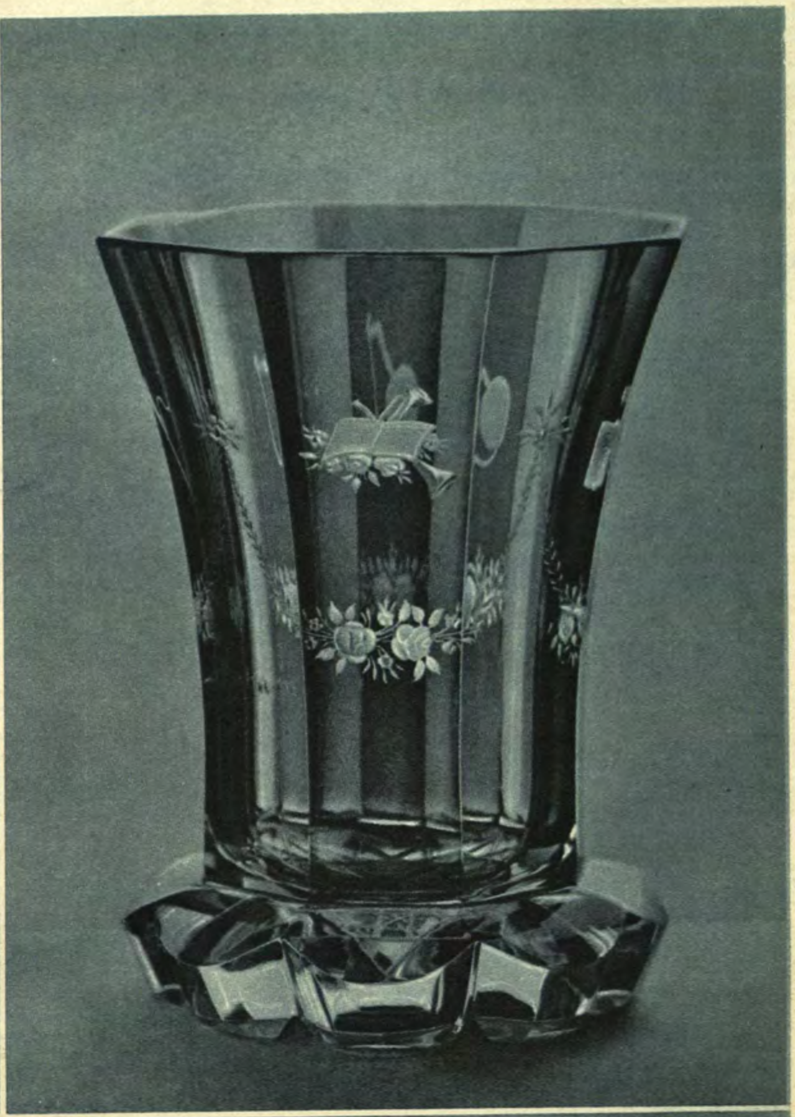


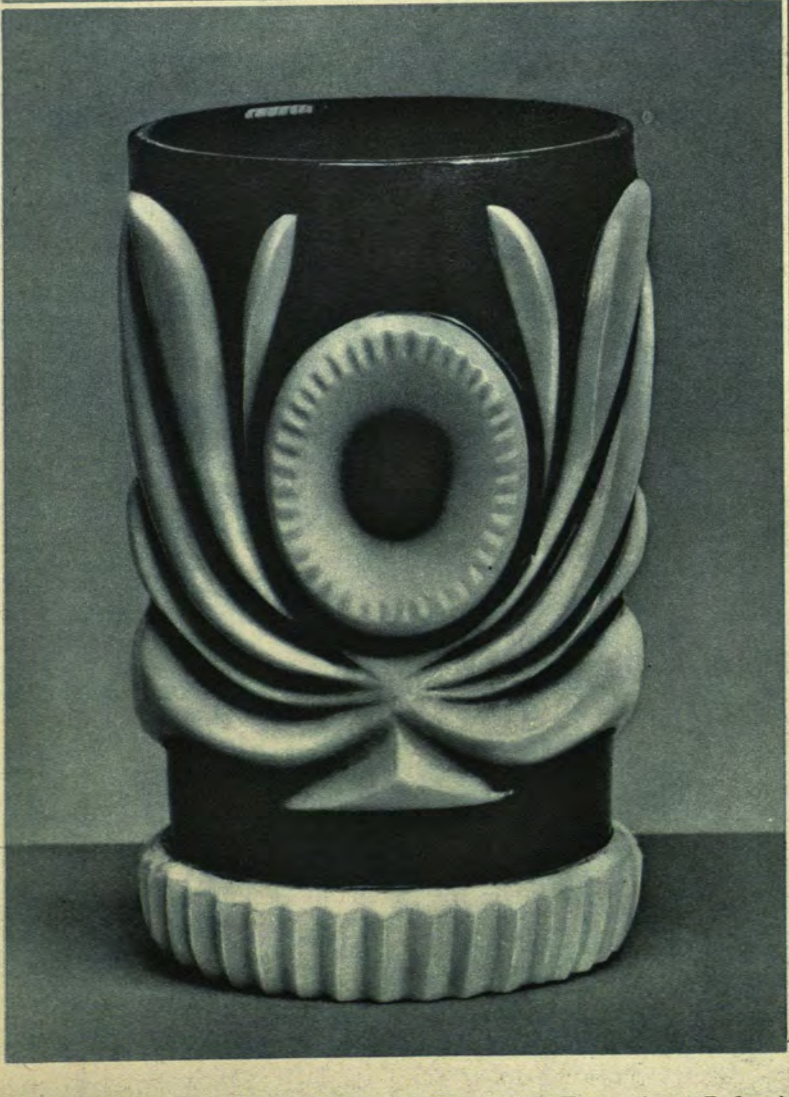
312. Glasses of Milk-Glass, with Enamel-Painted Decorations. Bohemia. End of 18th Cent. (PACM)

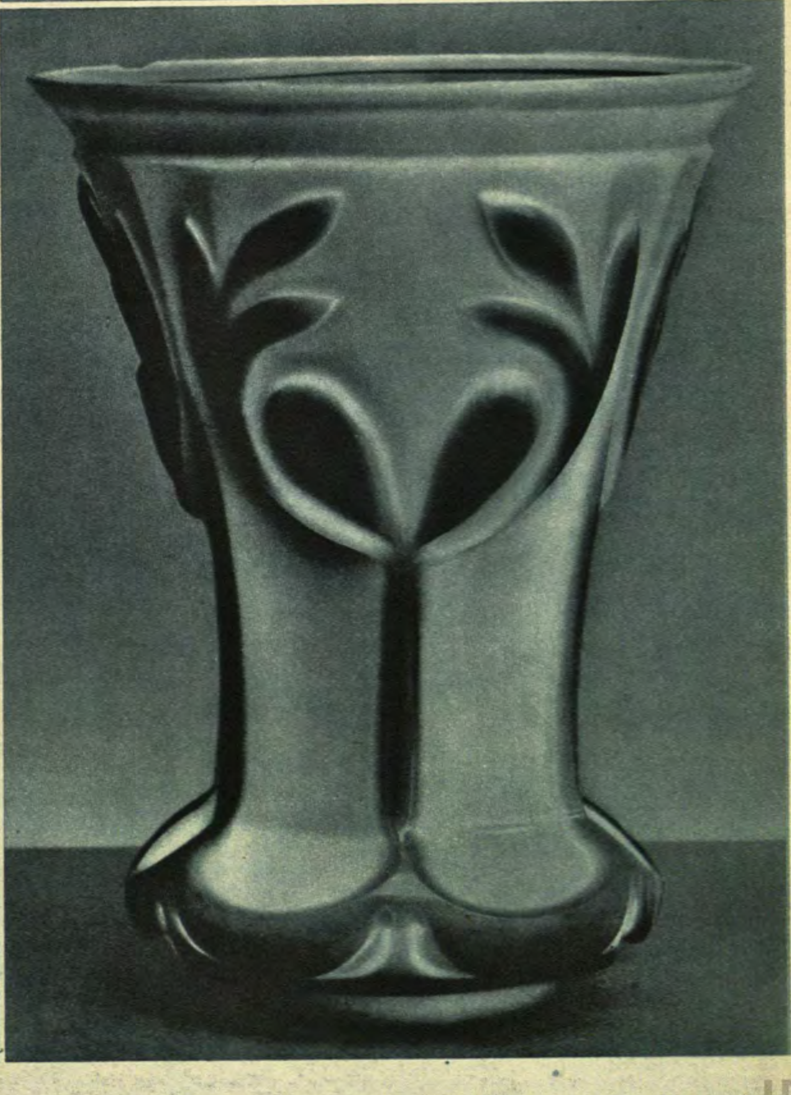


313. *Milk-Glass with Enamel Painting. Bohemia, End of 18th Cent. (PACM)*

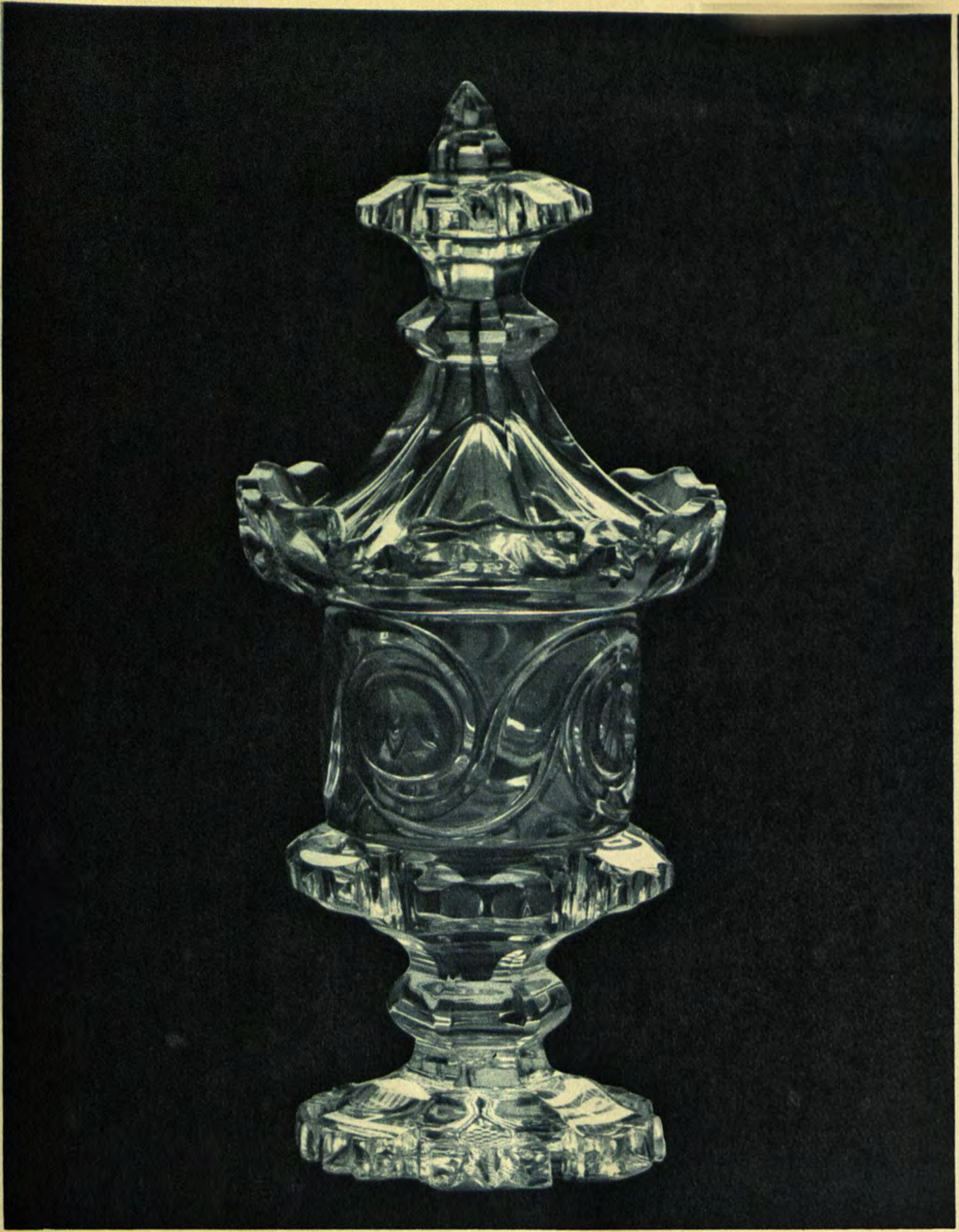




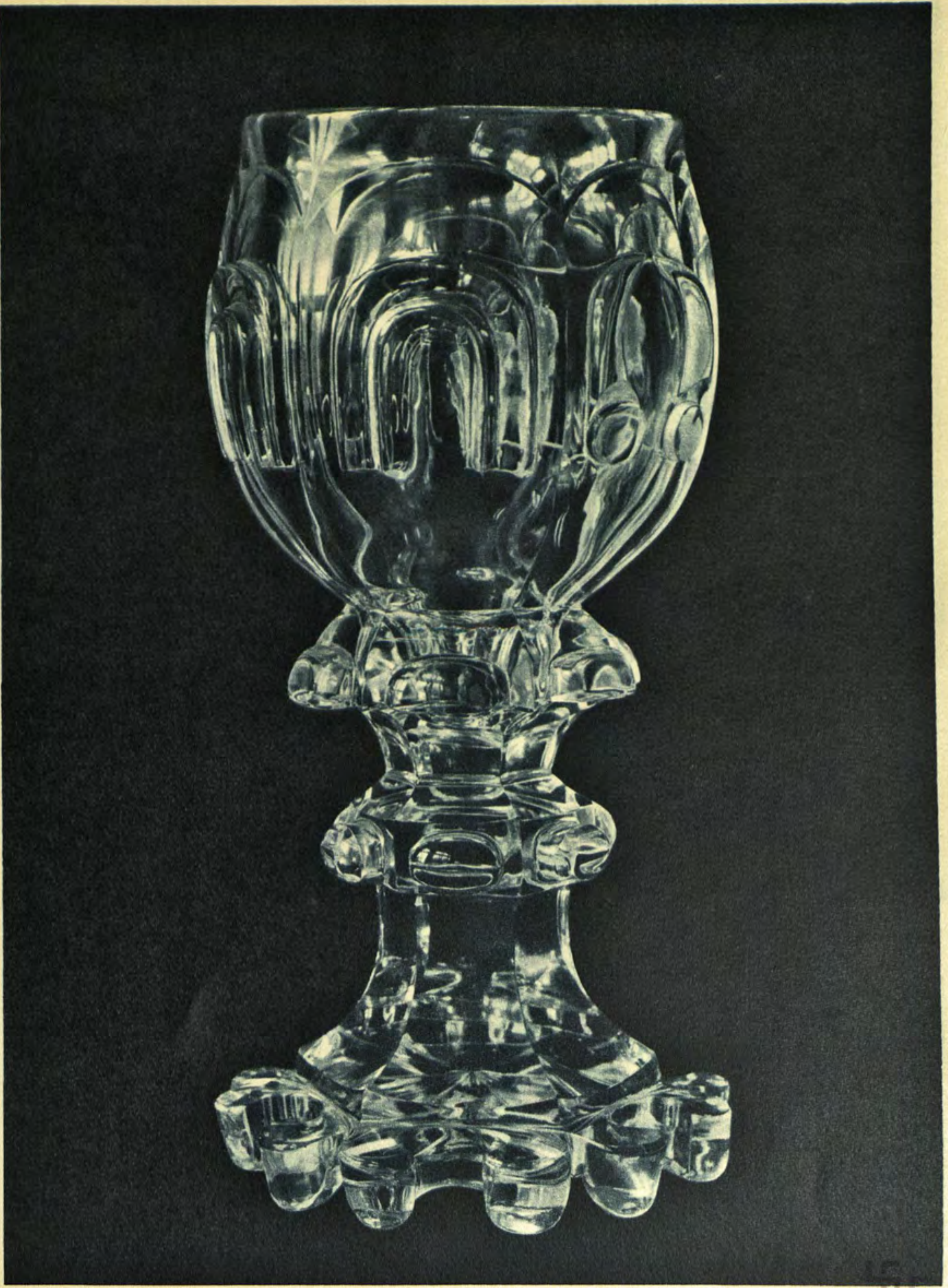




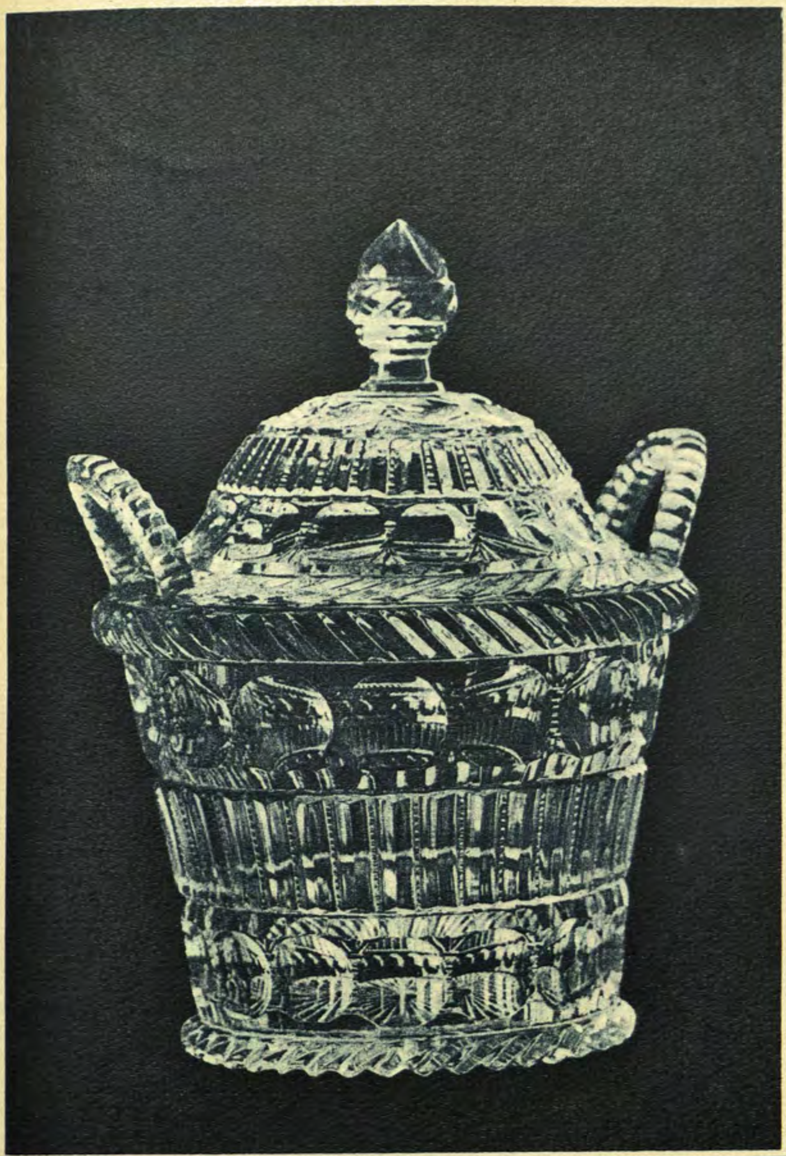
314. Transparent, Violet-Coloured Glass with Engravings. Bohemia, About 1830. 315. The Same, with Additional Cut Decorations. Same Period. 316. Dark Green Glass with Bone-Glass Layer Decorations. Bohemia, 1837. 317. Bone-Glass with Light Green Opaque Glass Decorations, Cut. Bohemia, Middle of 19th Cent.

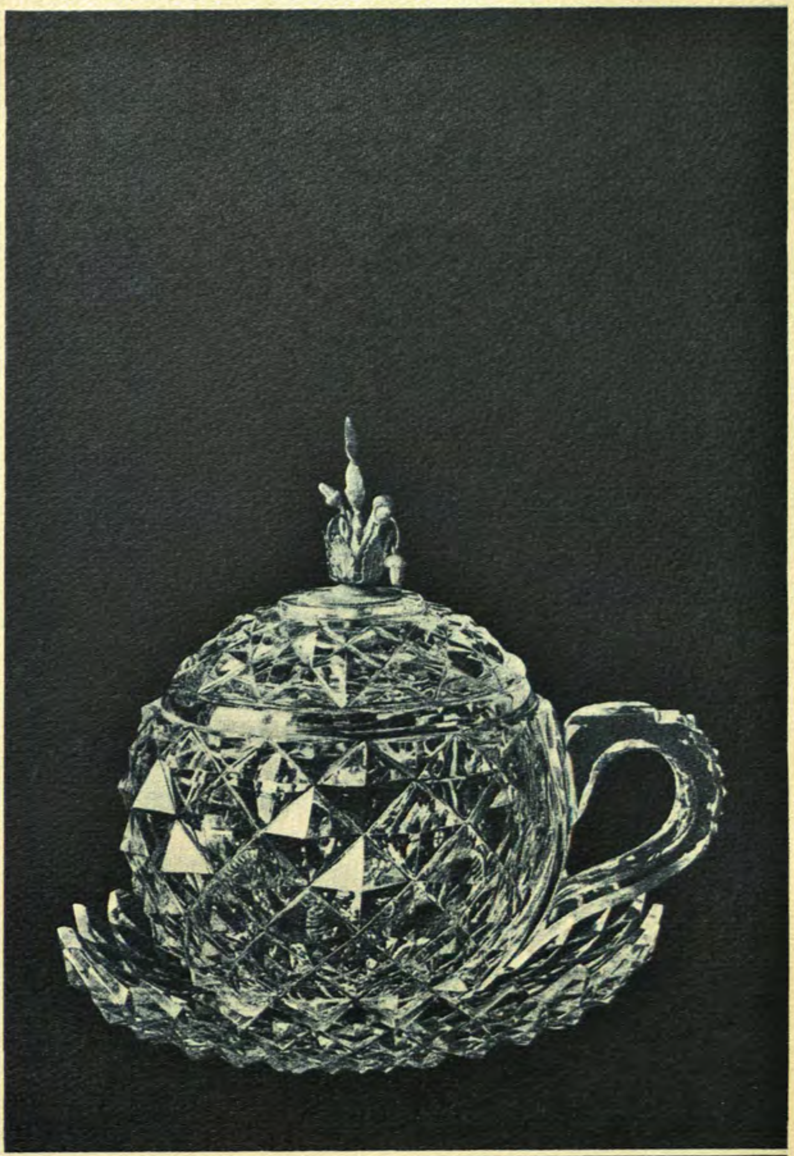


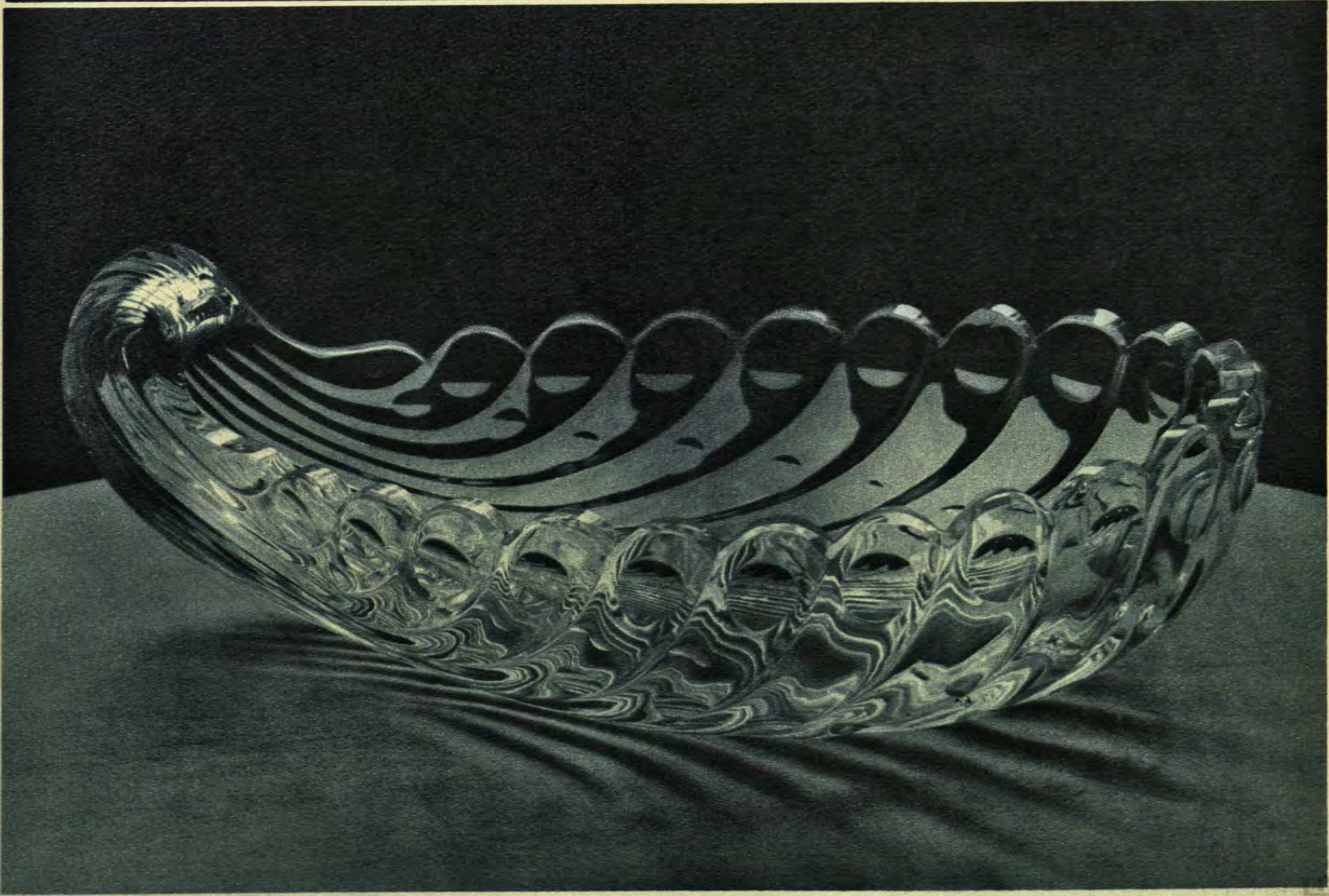
318. Lid Goblet of Cut-Glass, Etched with Red-Violet and Blue. Bohemia. Second Quarter of 19th Cent. (PACM) Photo: ÚLUV - J. Otto.



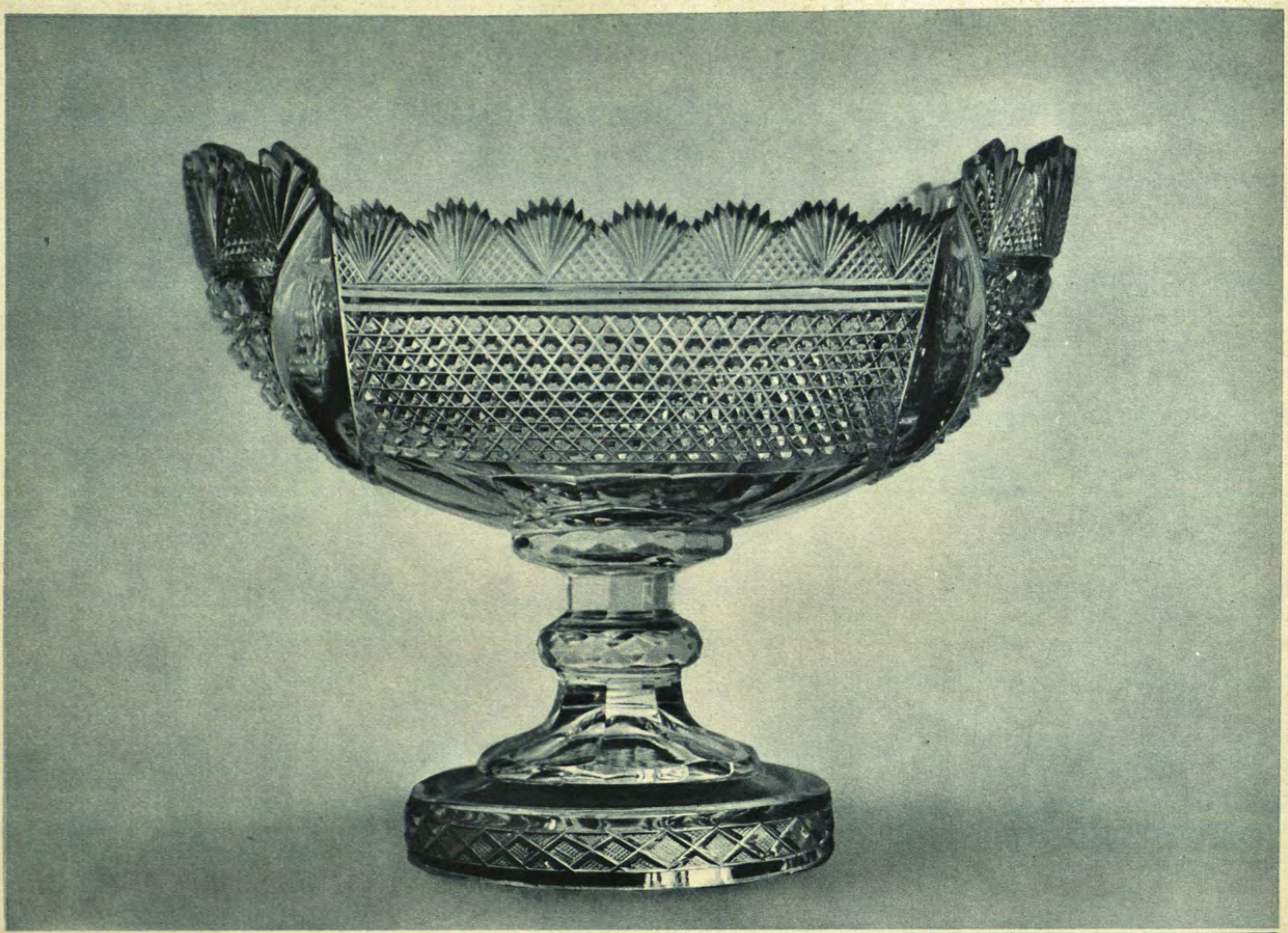
319. Magnificent Cut-Glass Goblet of Crystal-Glass. 19th Cent.

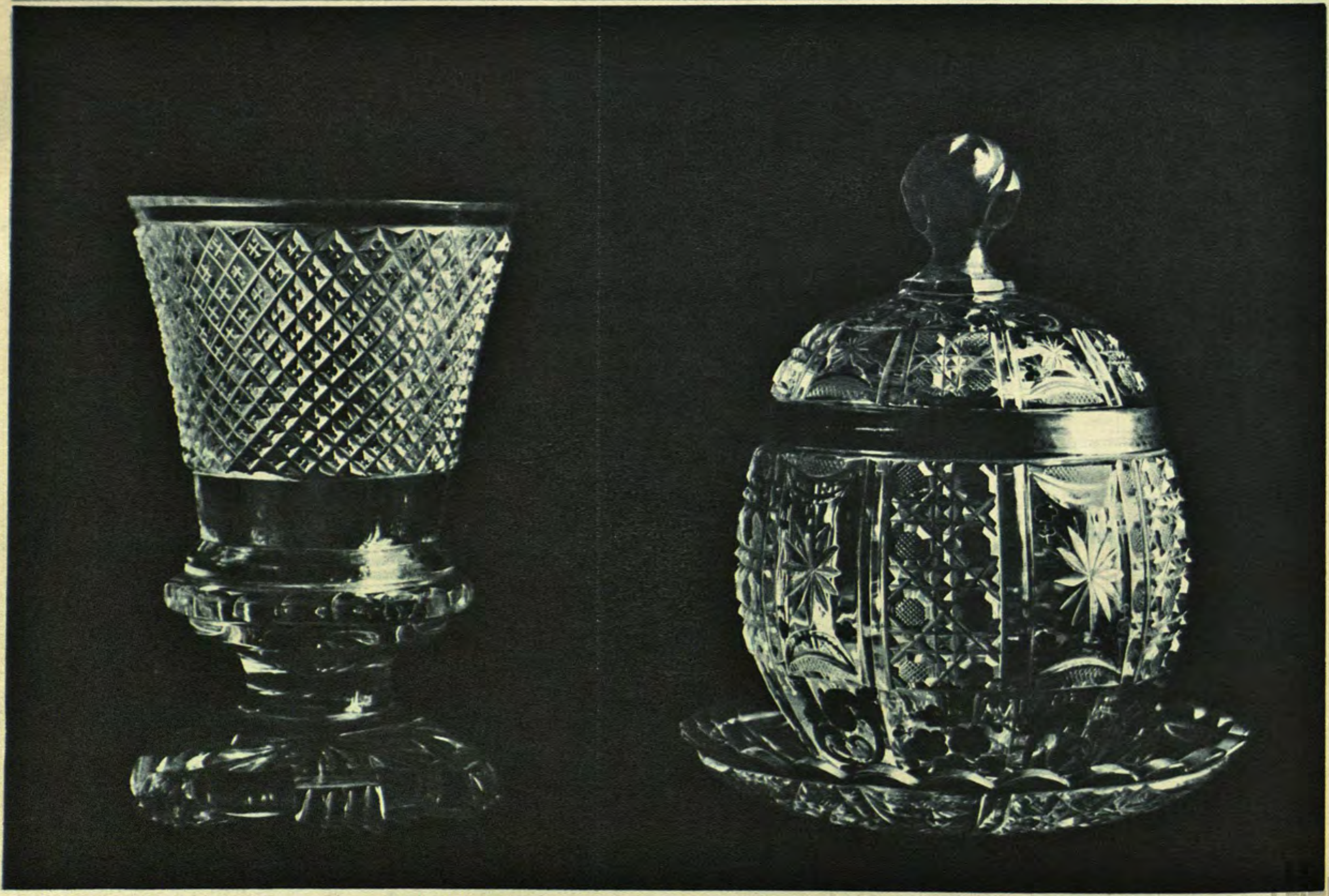




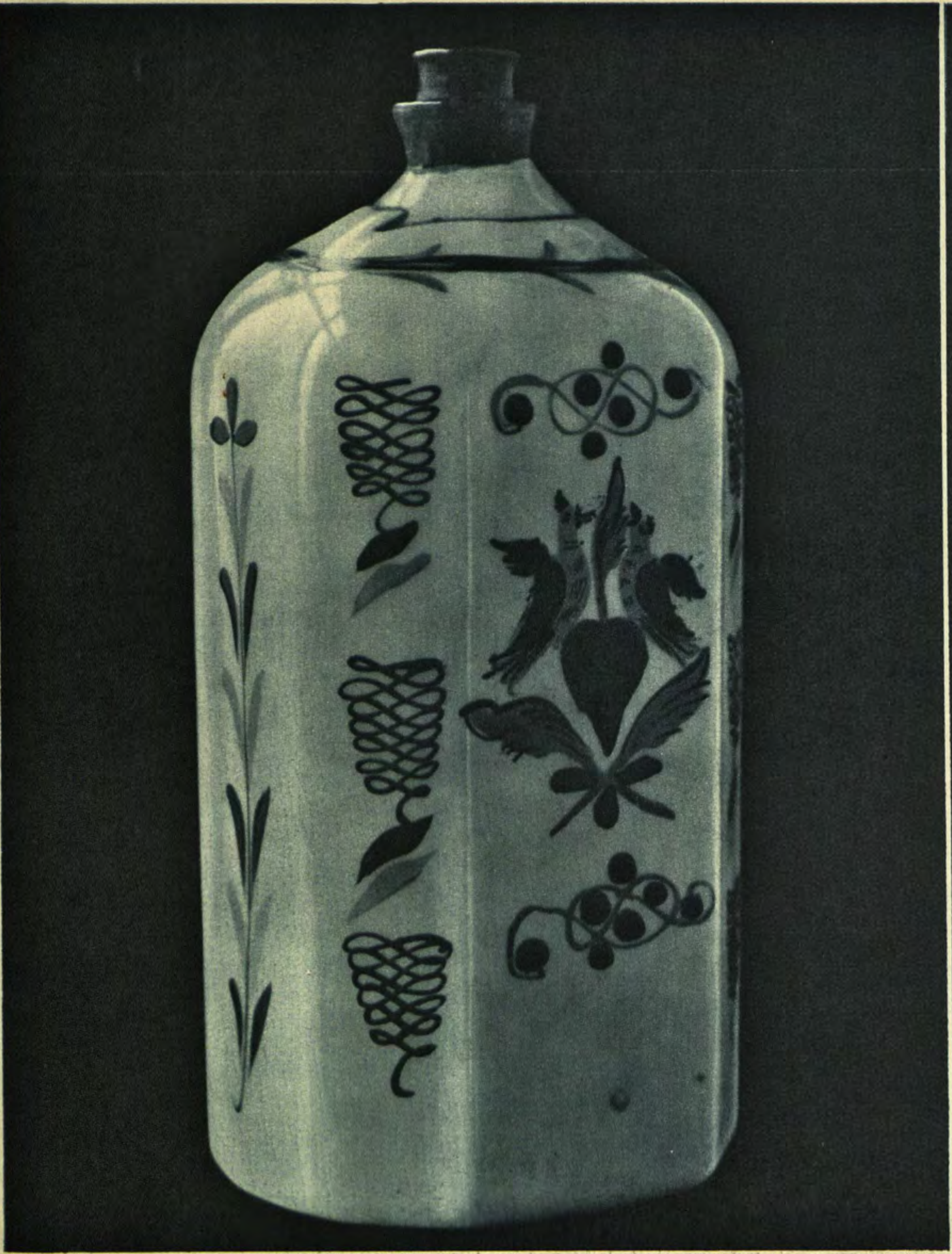


320. Cut-Glass Sugar Bowl. Harrachov Glass-Works 1818. 321. Cut-Glass Vessel with Lid. First Half of 19th Cent. (PACM)
322. Cut-Glass Dish, Shell-Shaped. First Half of 19th Cent. ÚLUV. Photo: J. Otto.

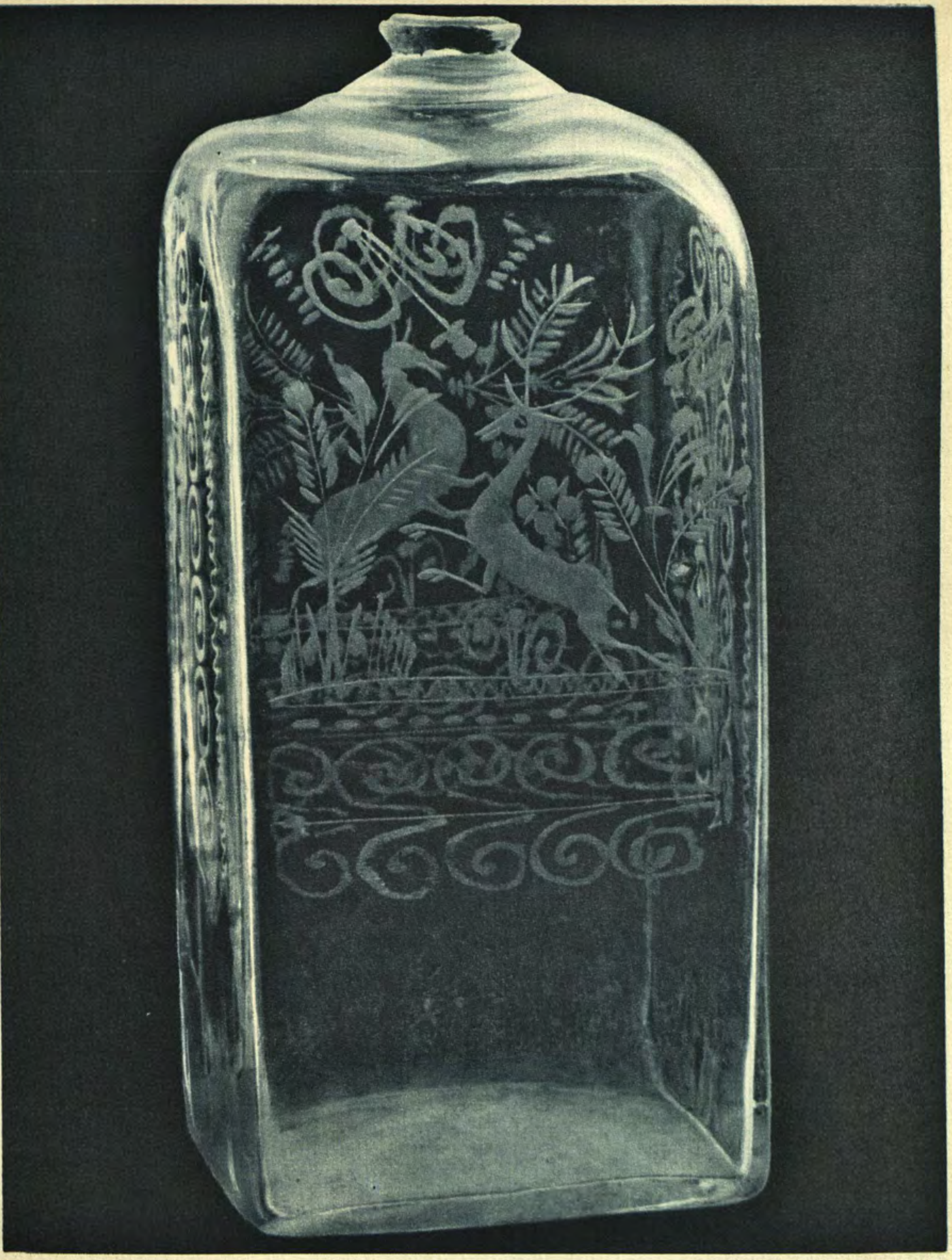




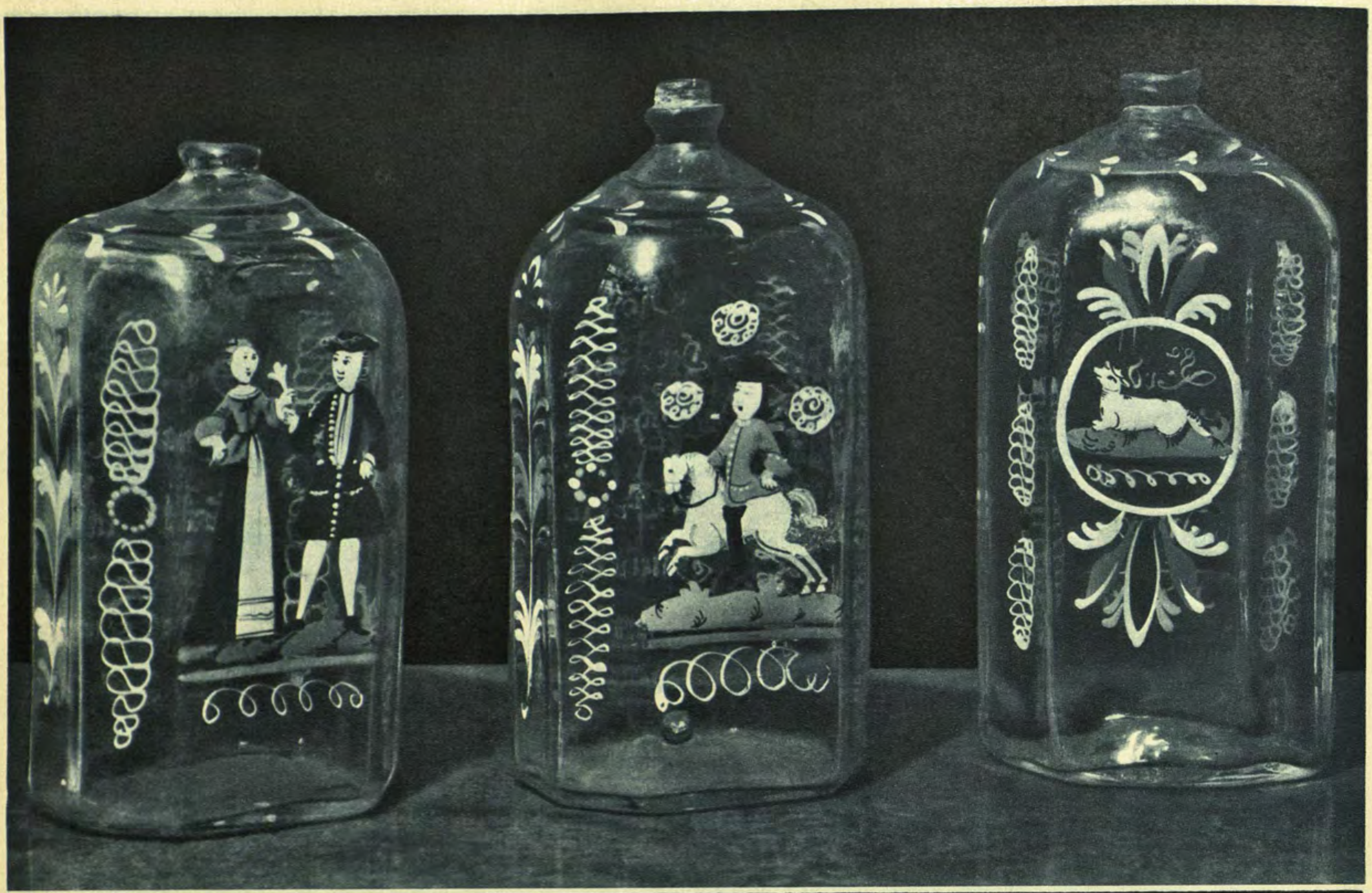
323. Goblet with Brilliant Cut. About 1840. (PACM)
324. Bohemian Cut-Glass from the First Half of 19th Cent.

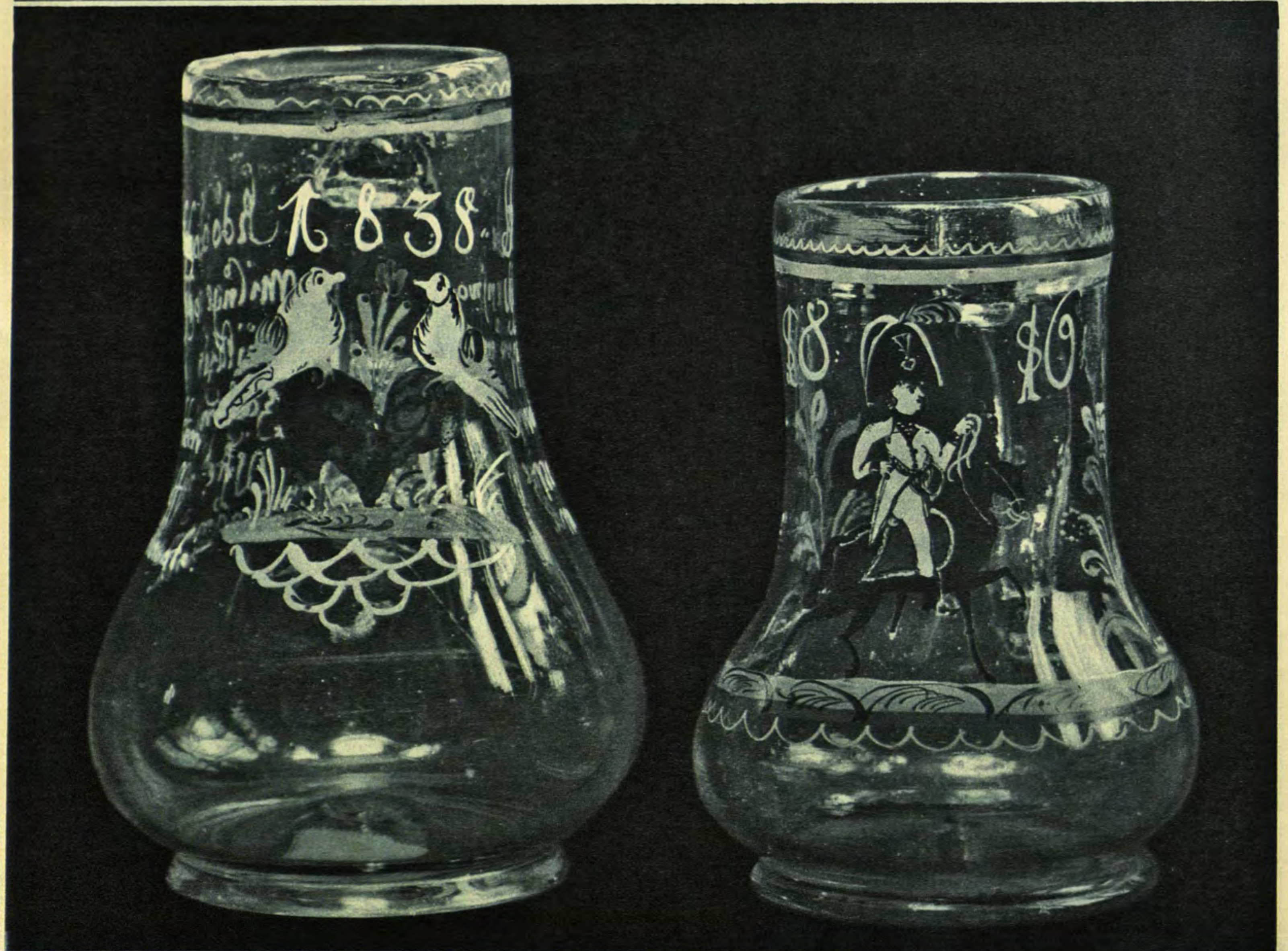


325. Six-Cornered Folk Wedding Glass, Milk-Glass, Metal Stopper. Photo: ÚLUV - J. Otto.

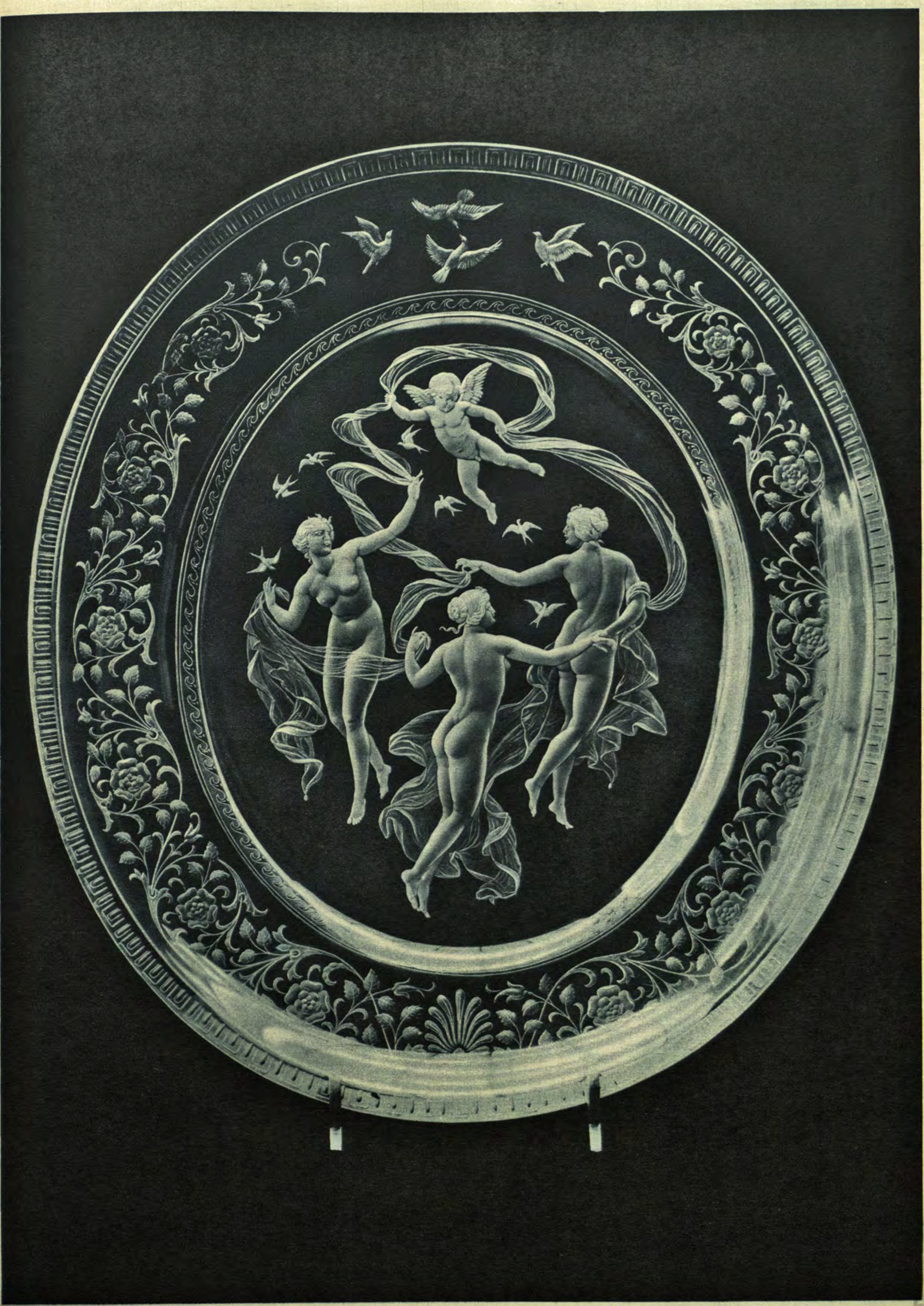


326. Four-Cornered Wedding Glass, with Engraved Decorations. Glass-House at Březina. Beginning of 19th Cent. Photo: ÚLUV - J. Otto.

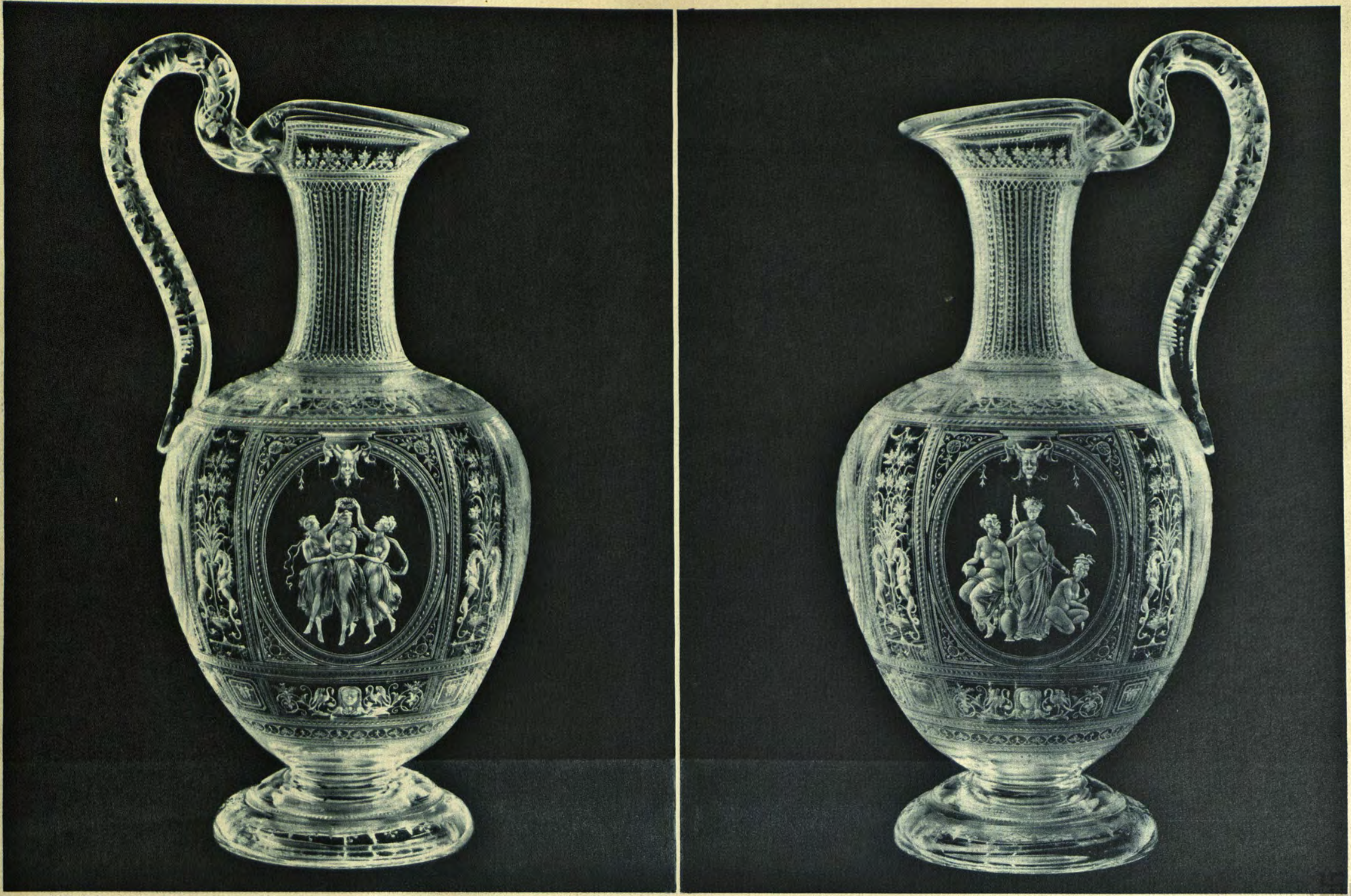




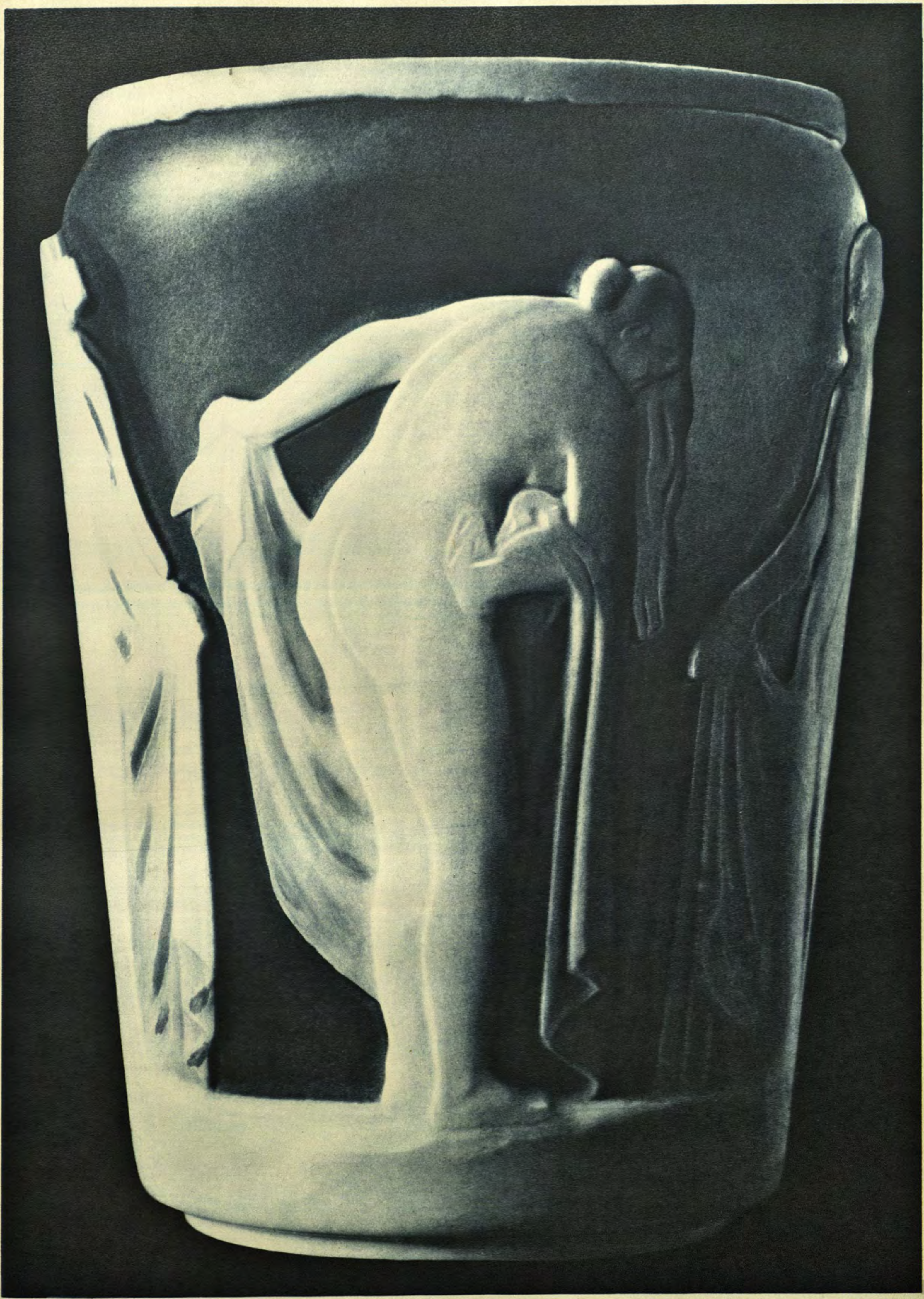
327. Three Folk Glasses with Painted Motifs. The one on the Right from the Year 1774. Photo: ÚLUV - J. Otto.
328. Two Folk Jugs, Enamel Paint. Inscriptions. Dated 1816 and 1858. Photo: ÚLUV - J. Otto.



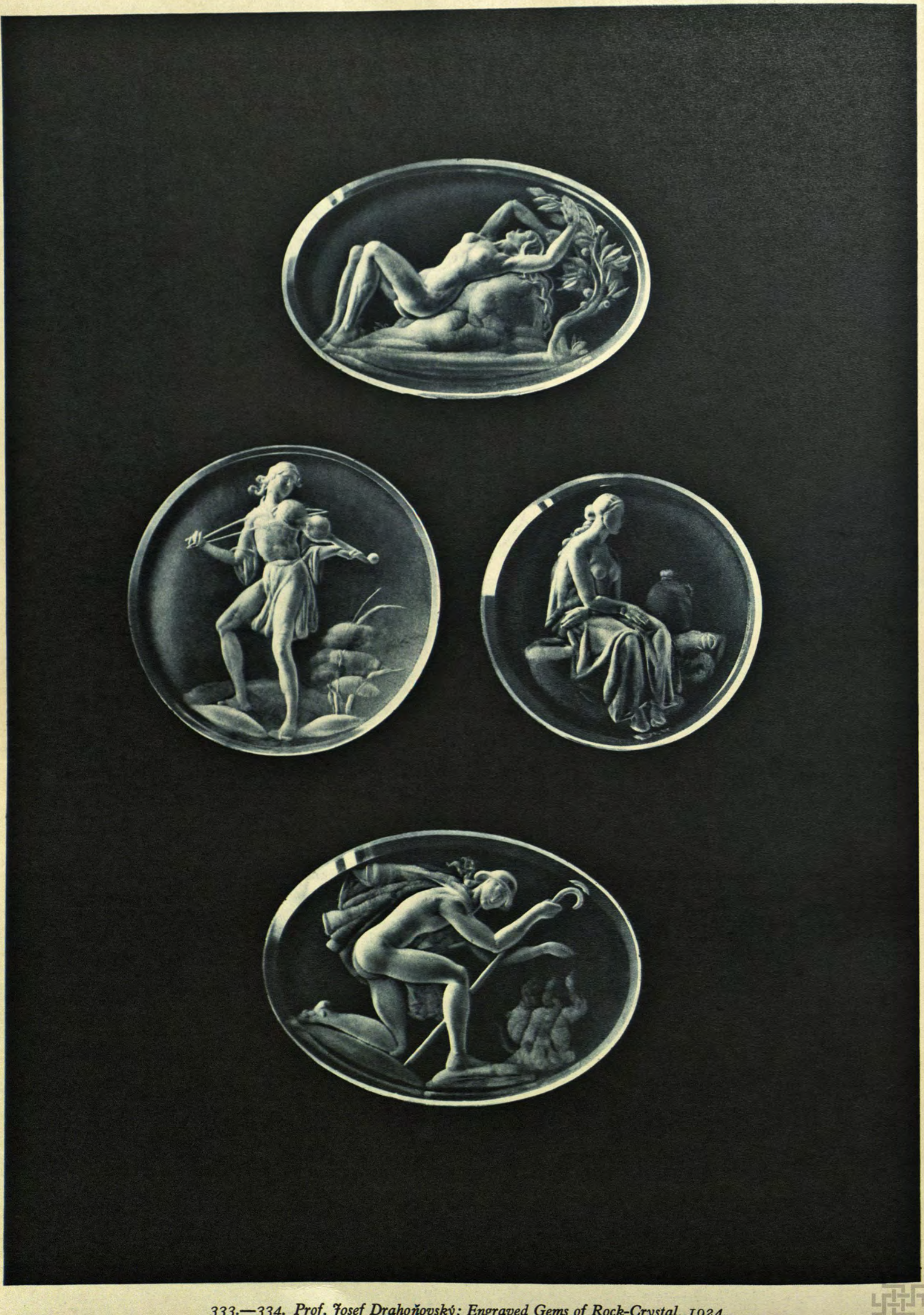
329. Engraved Dish of Crystal-Glass. Designed by A. Eisenmenger. Edge by M. Knab. Made by F. Ullmann at the J. & L. Lobmeyr Works in Kamenický Šenov, About 1880.



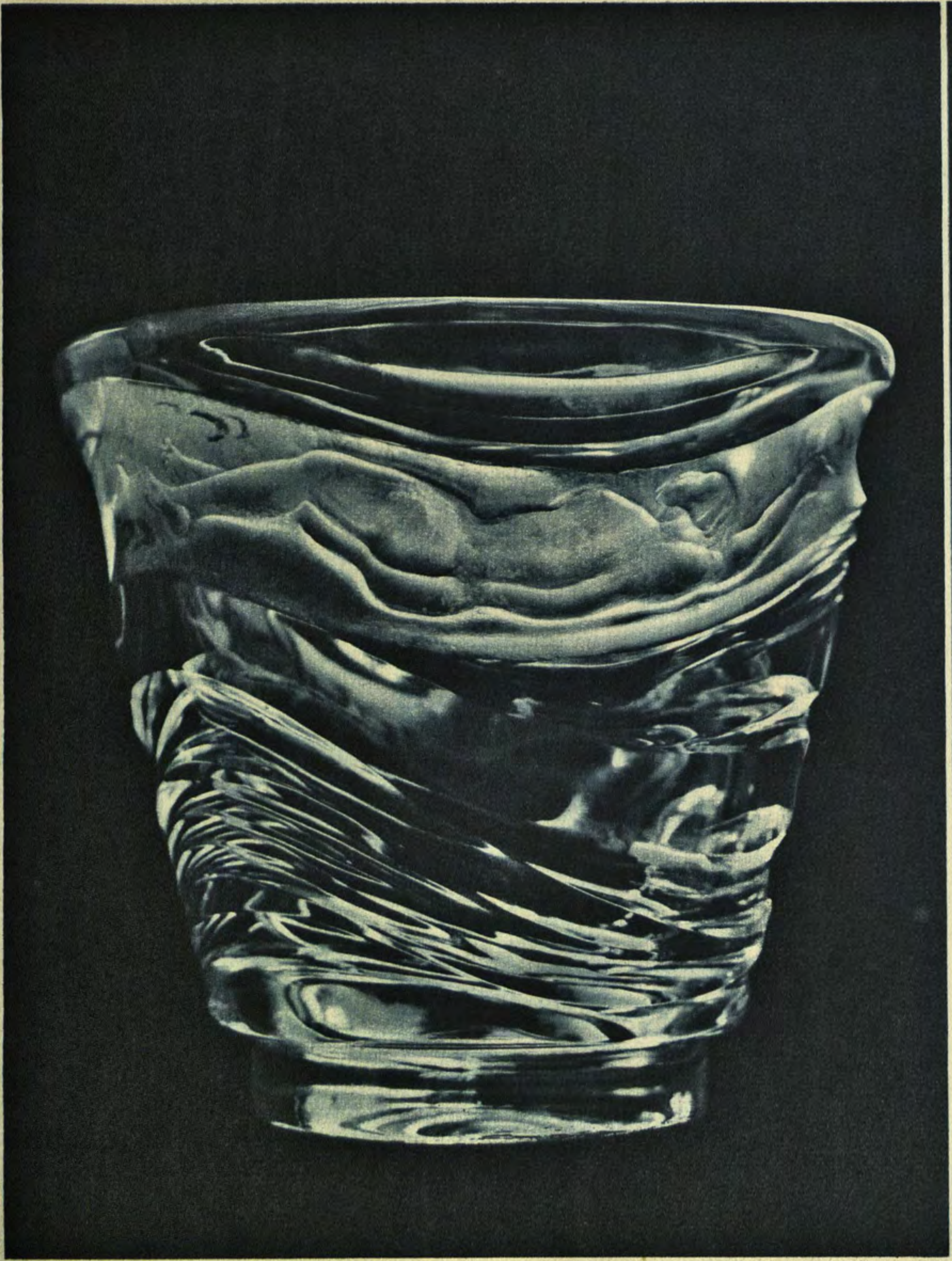
330.—331. Small Jugs of Crystal-Glass, Richly Decorated with Engravings. Executed by Herrmann Müller in Mistrovice at about 1875. (PACM) Photo: J. Brok, Prague.



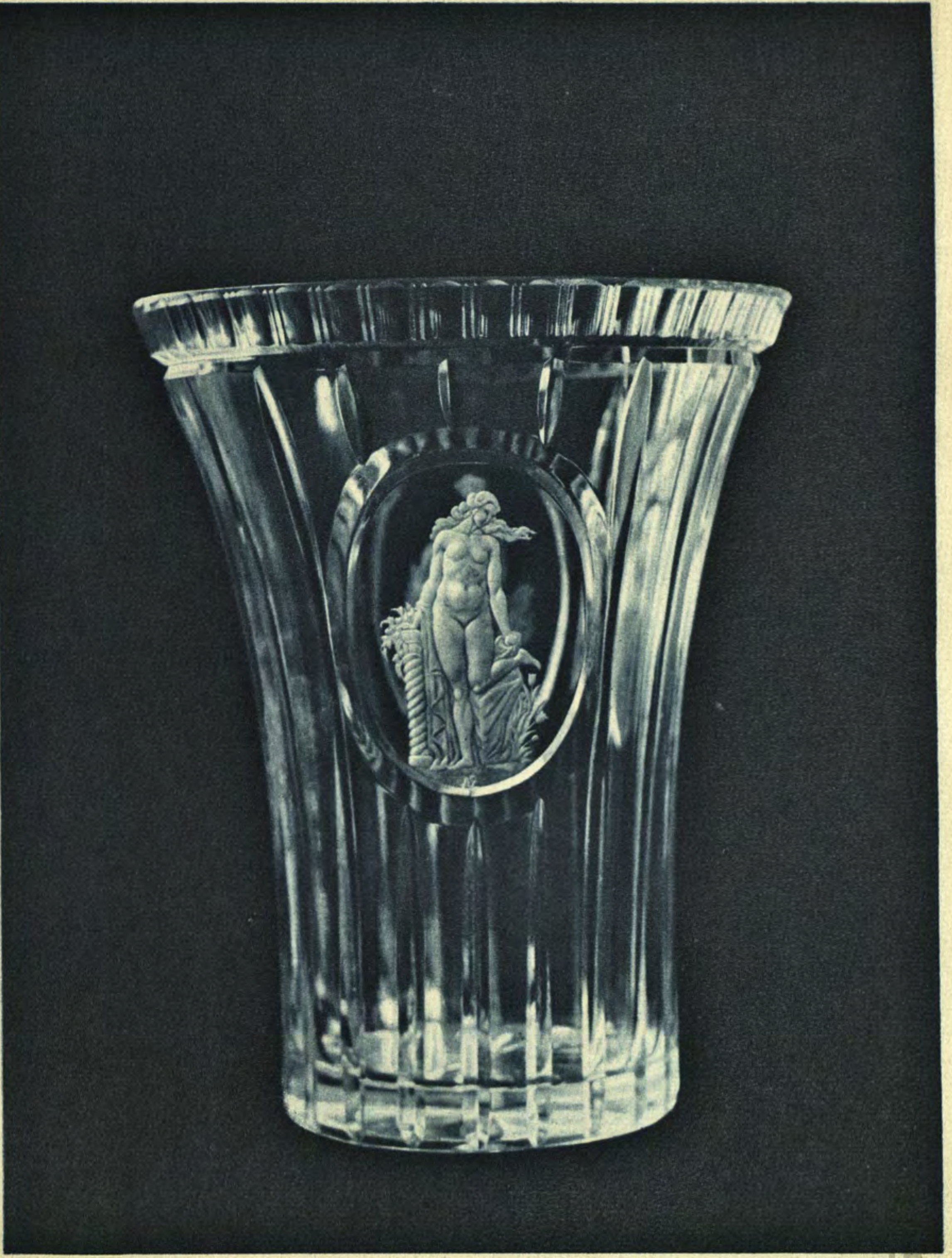
332. *Prof. Josef Drahoňovský: "The Bathe", Three-Coloured, Opaque Glass.*



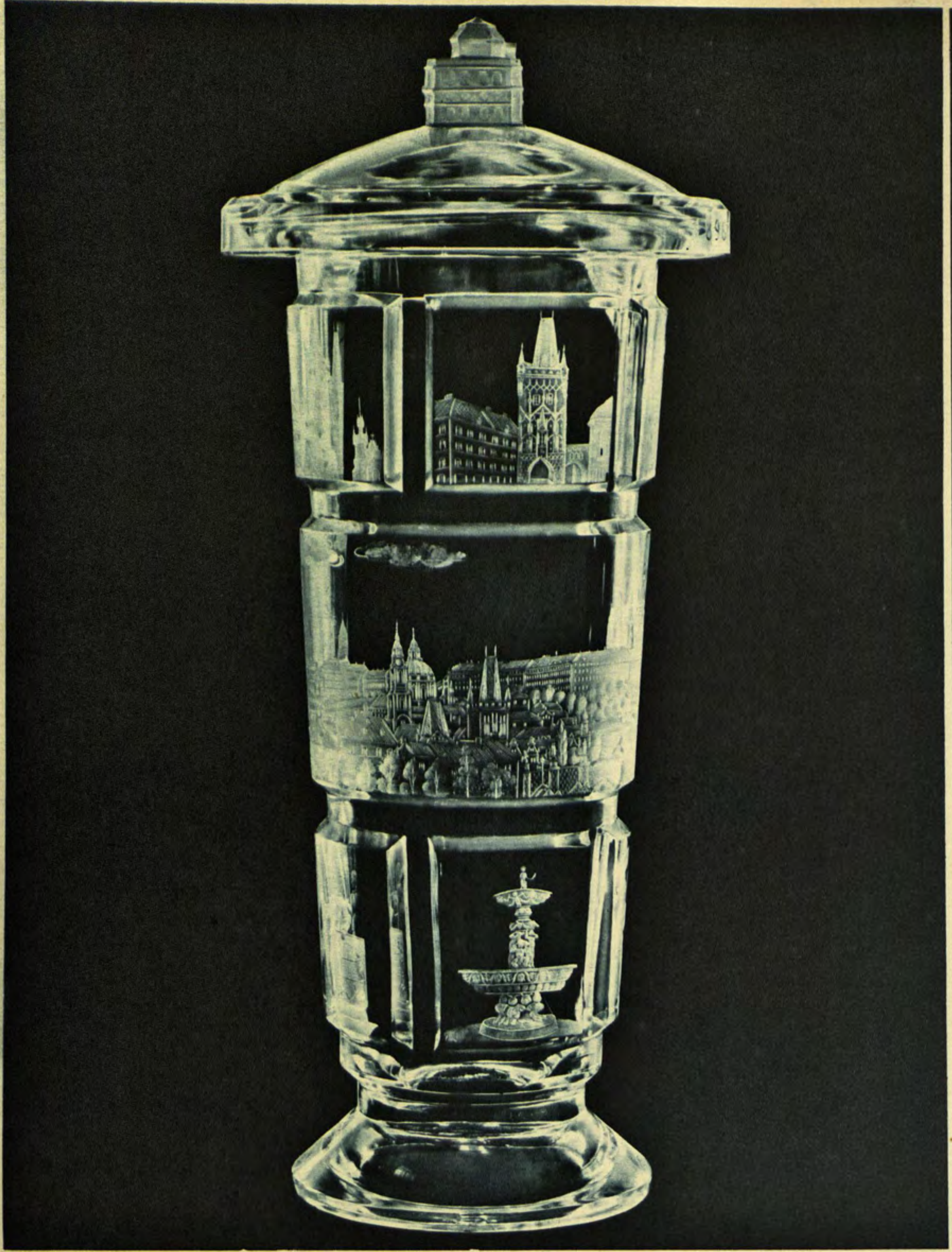
333.—334. *Prof. Josef Drahoňovský: Engraved Gems of Rock-Crystal. 1924.*



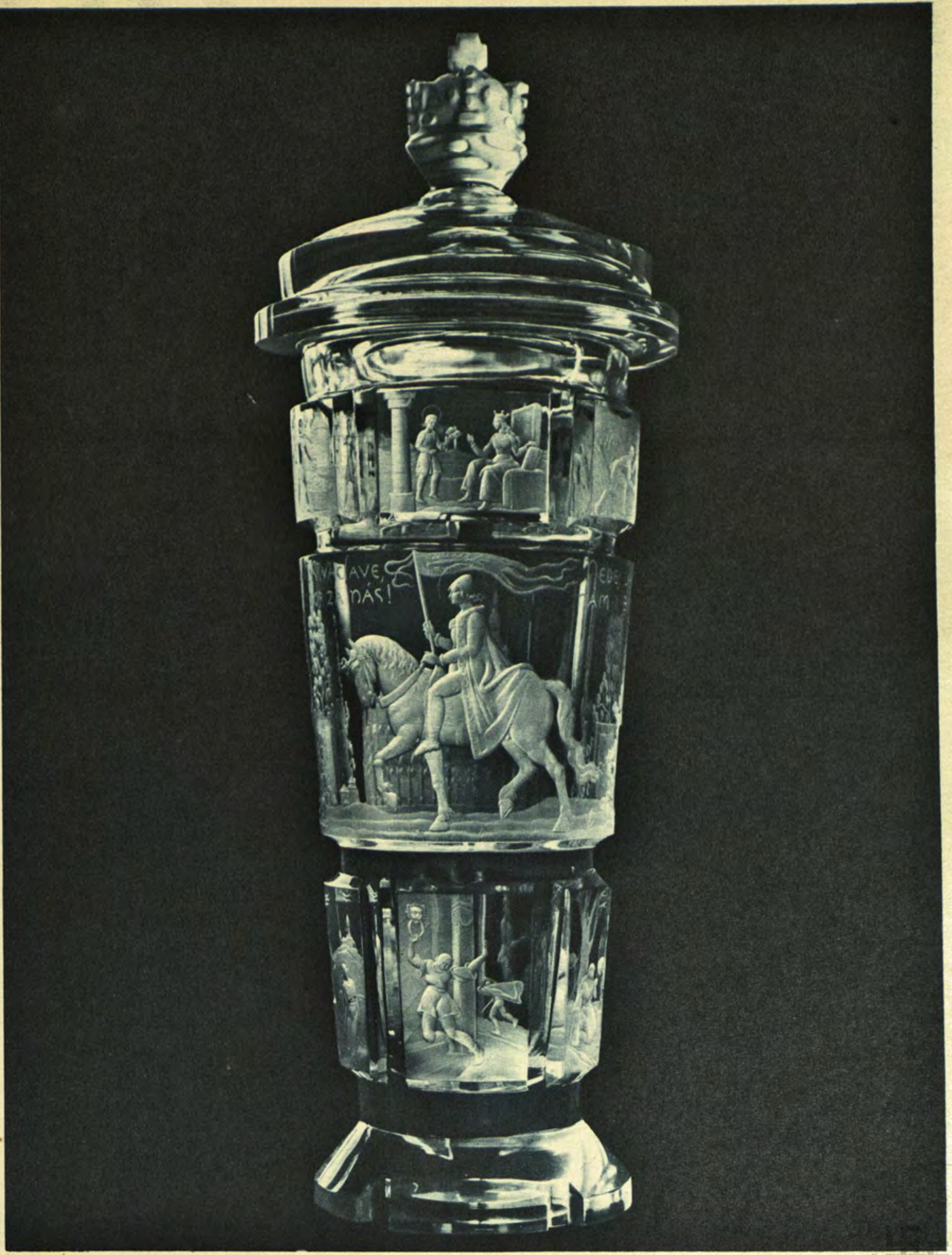
335. Prof. J. Drahoňovský: Cut and Engraved Vase "On the Waves" 1912. (PACM)



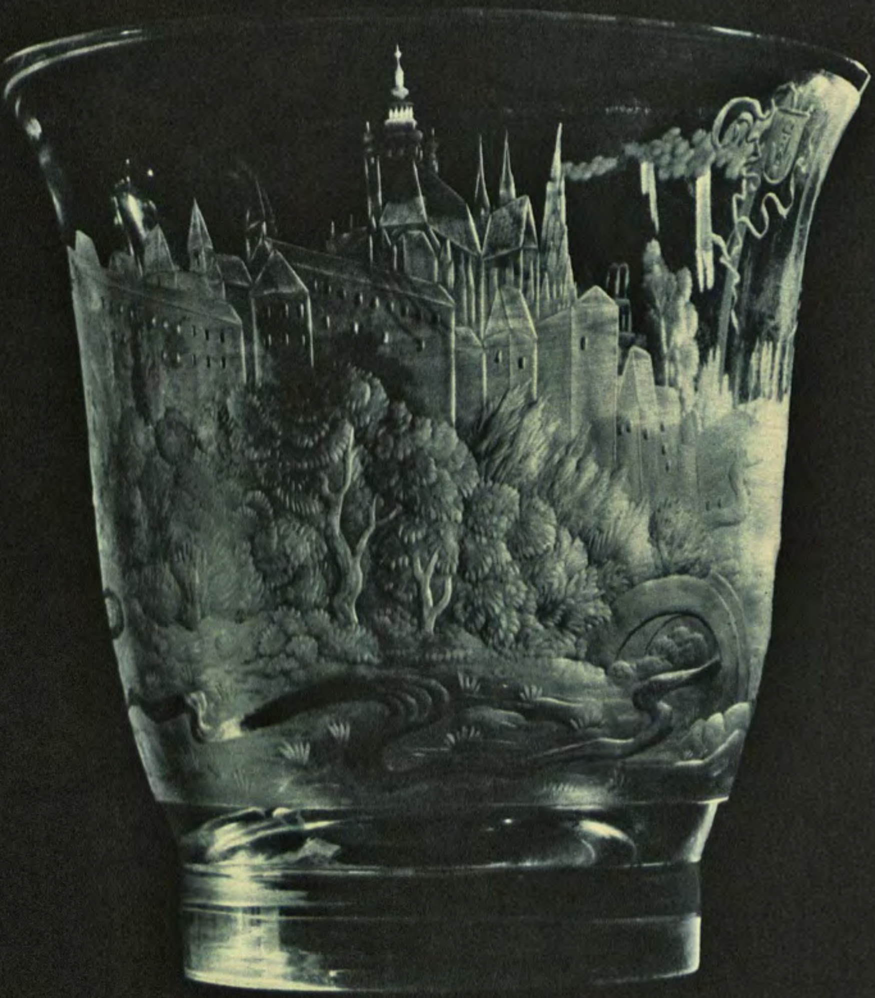
336. Prof. J. Drahoňovský: Engraved and Cut Glass. 1923.



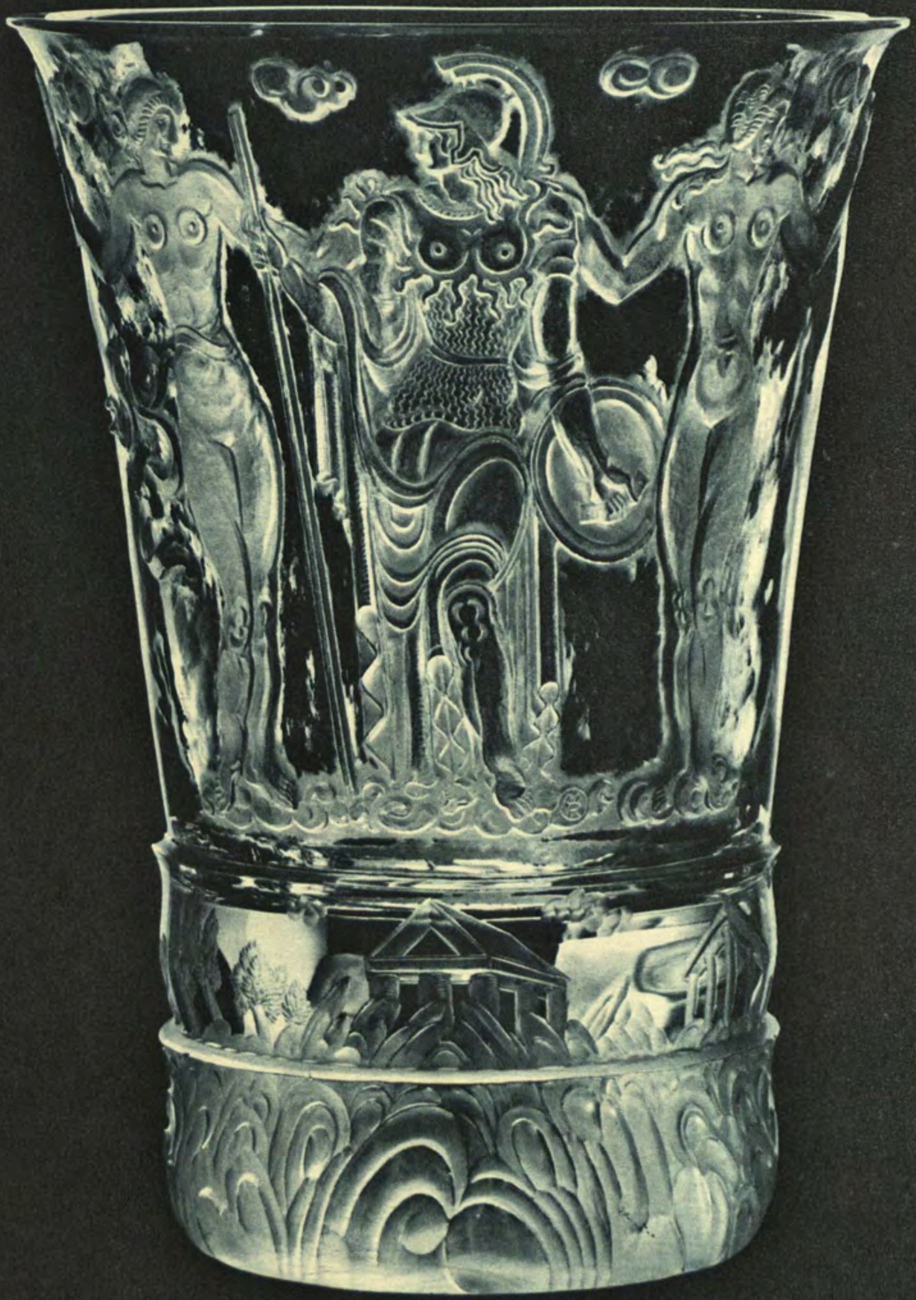
337. Prof. J. Drahoňovský: "Prague". Cut and Engraved Vase with Lid. 1935. Photo: J. Brok, Prague.



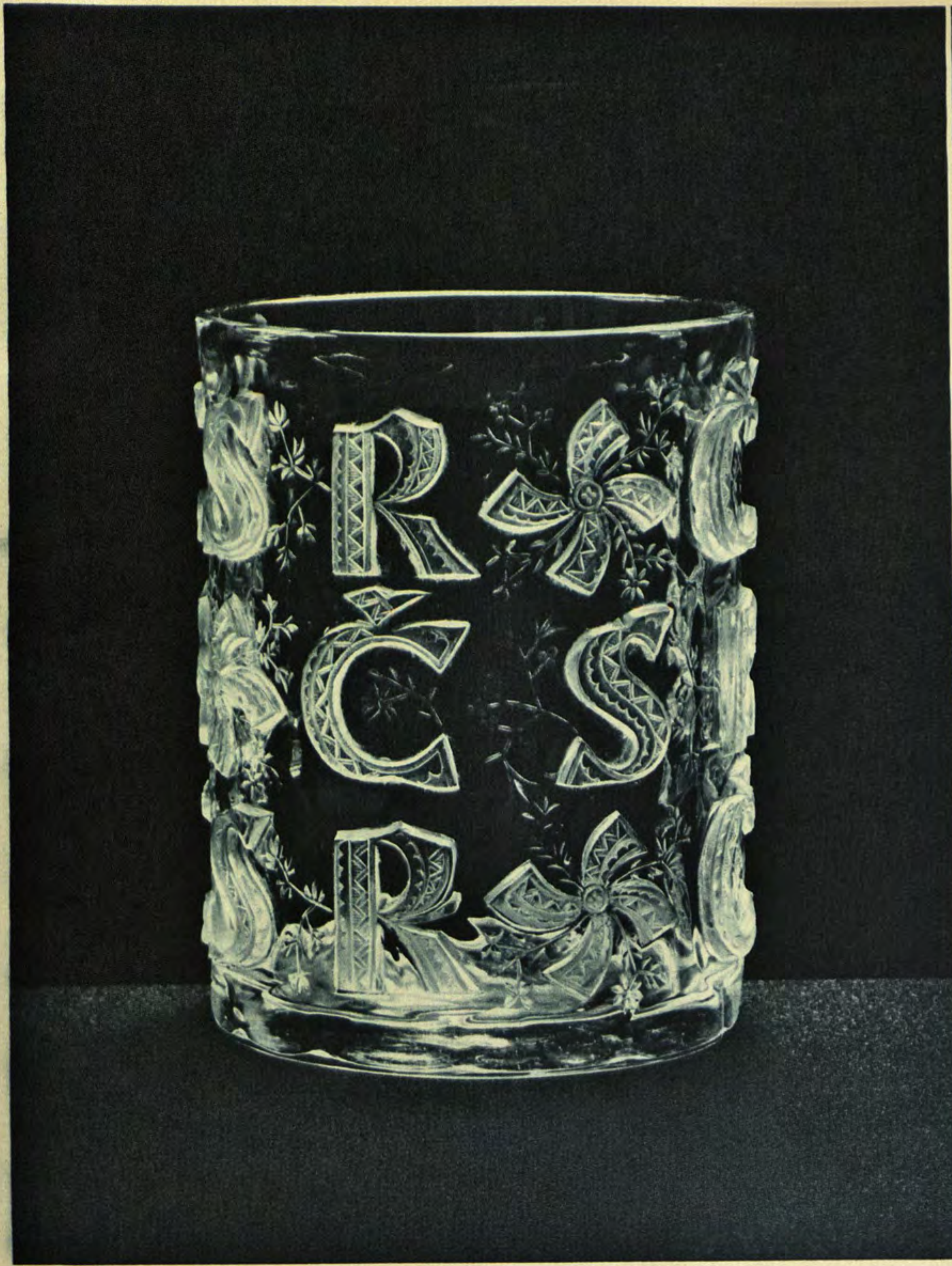
338. Prof. Josef Drahoňovský: St. Wenceslas Vase with Lid, Cut About 1930. (PACM) Photo: J. Brok, Prague.



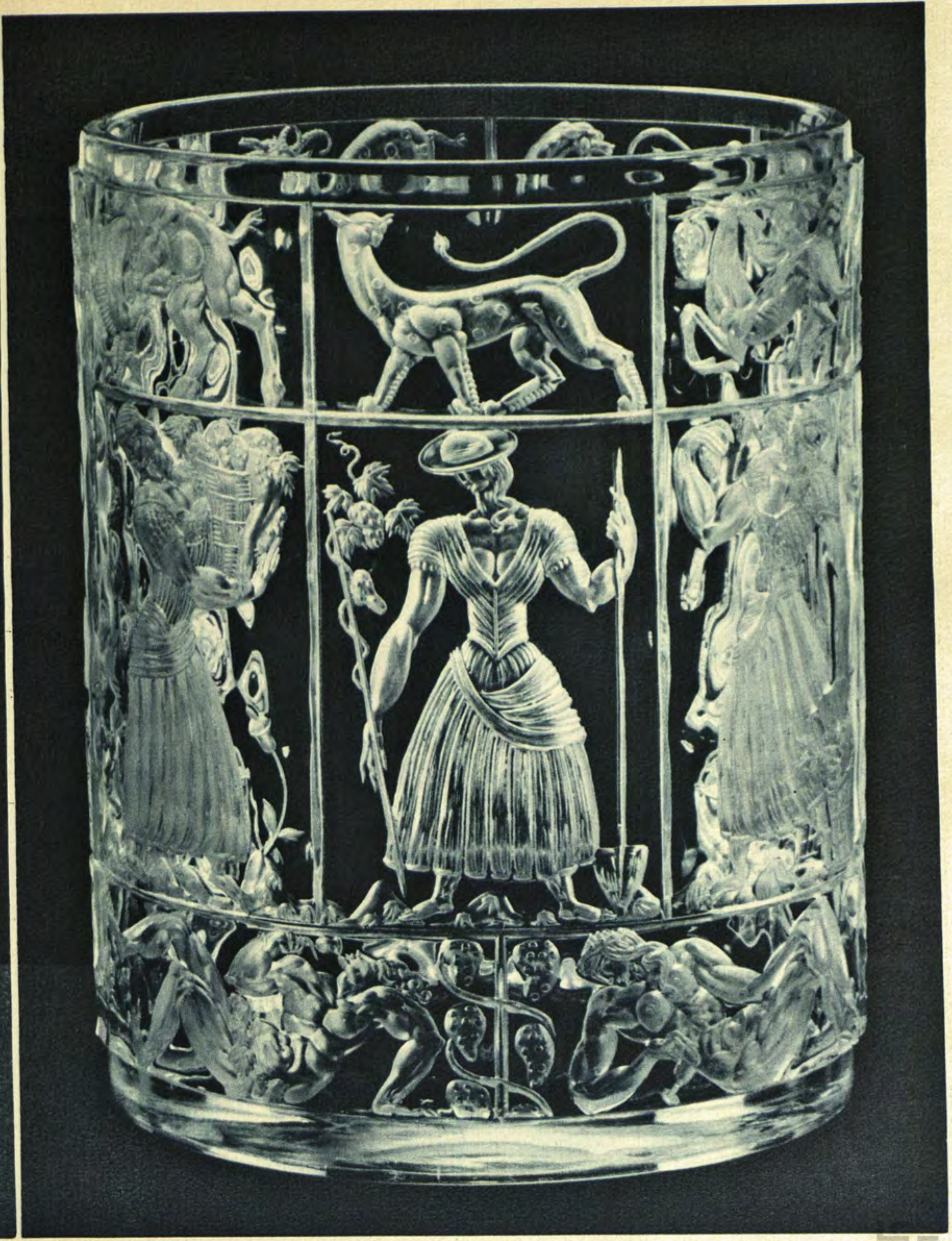
339. *Prof. Jaroslav Horejc: "Prague" Cut Vase of Crystal-Glass.*



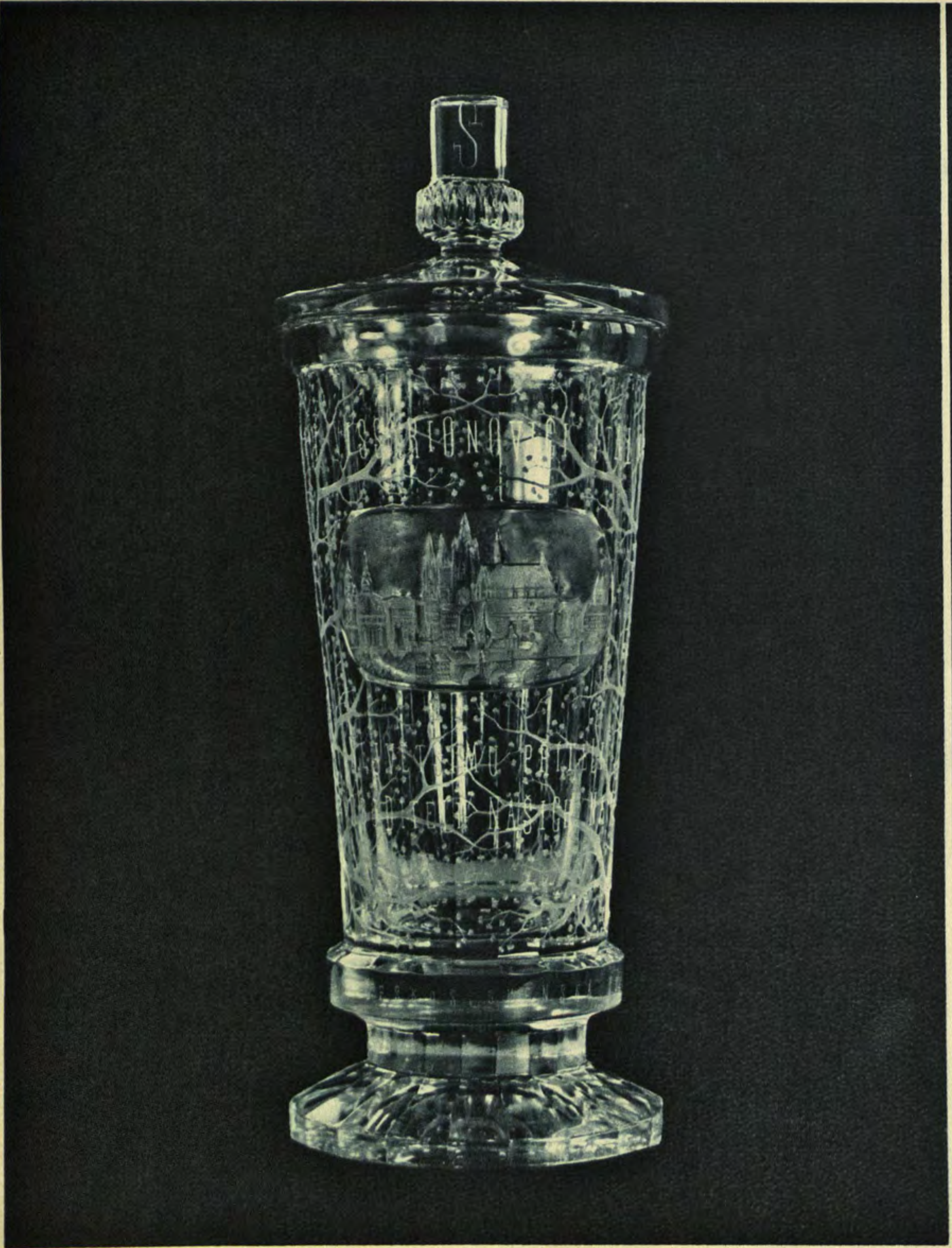
340. *Prof. J. Horejc: "The Three Graces" Cut Crystal-Glass Goblet. Executed by the National Enterprise "Artistic Glass", Lobmeyr, Kam. Šenov. Photo: J. Brok, Prague.*



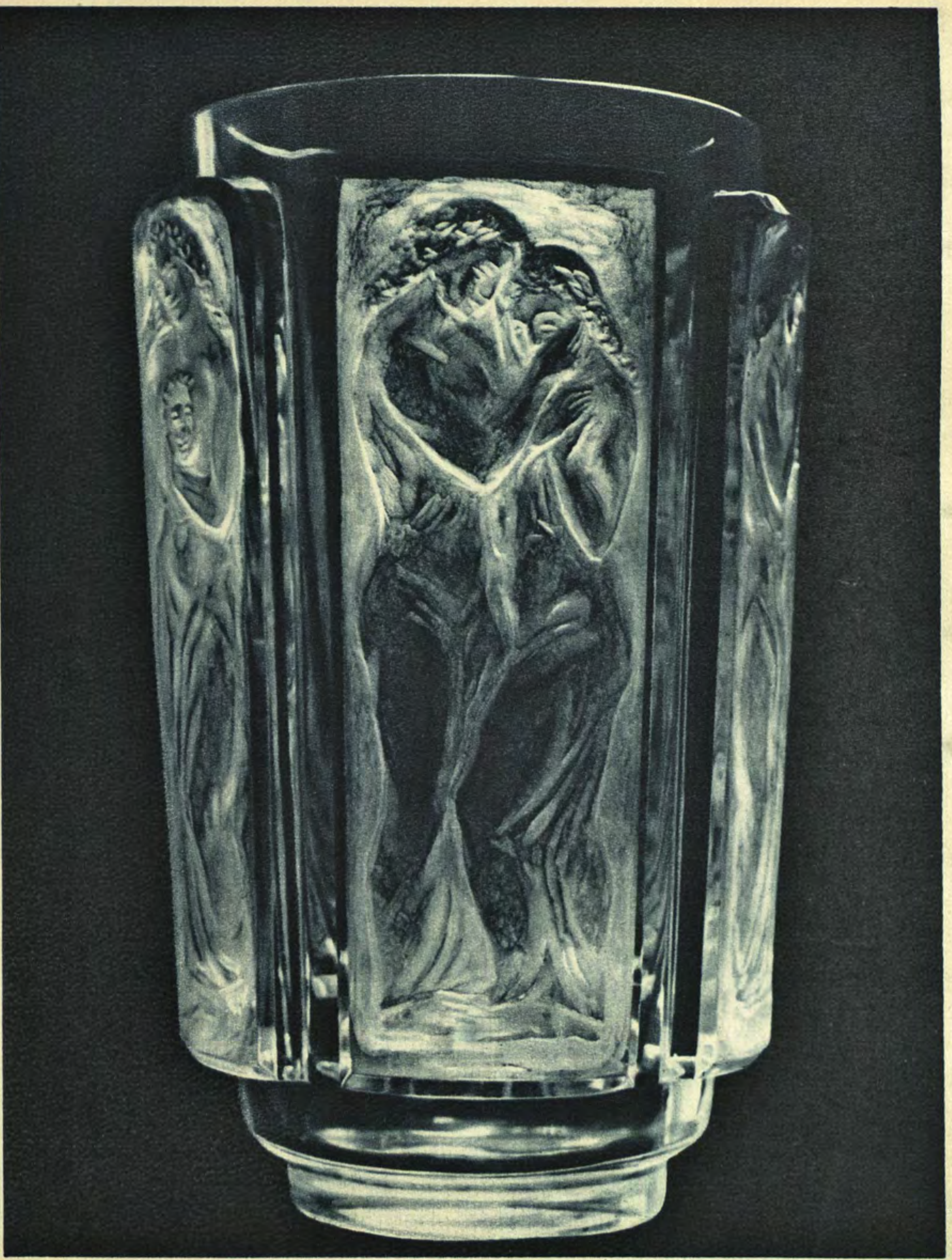
341. *F. Kysela: Relief-Cut Glass with Inscription "ČSR", Executed by the National Enterprise "Artistic Glass" Lobmeyr Works, Kam. Šenov. Photo: J. Brok, Prague.*



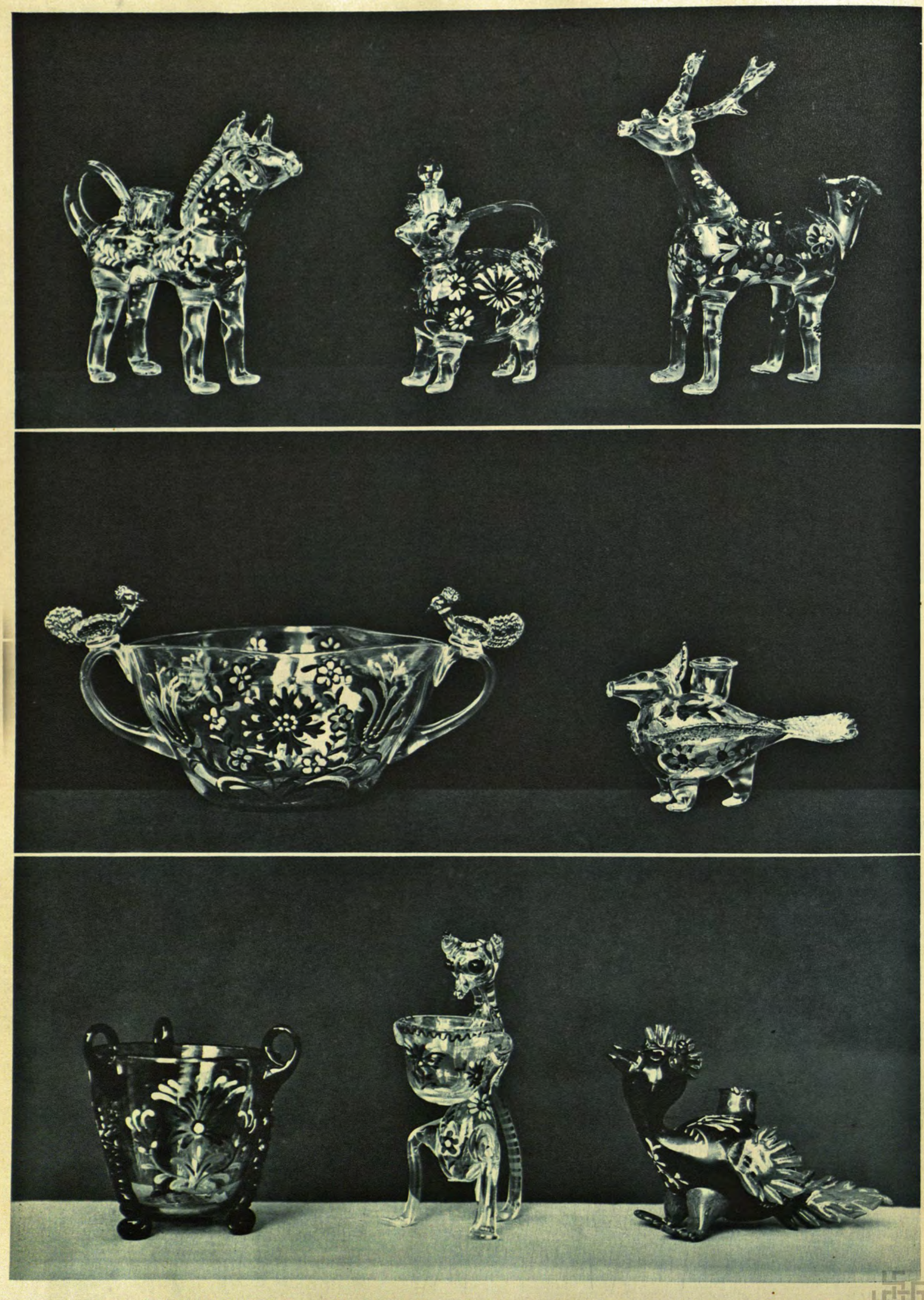
342. *Prof. Jaroslav Horejc: "Canaan, The Land of Promise" N. E. "Artistic Glass", Lobmeyr Works, Kam. Šenov. 1923. (PACM) Photo: J. Brok, Prague.*



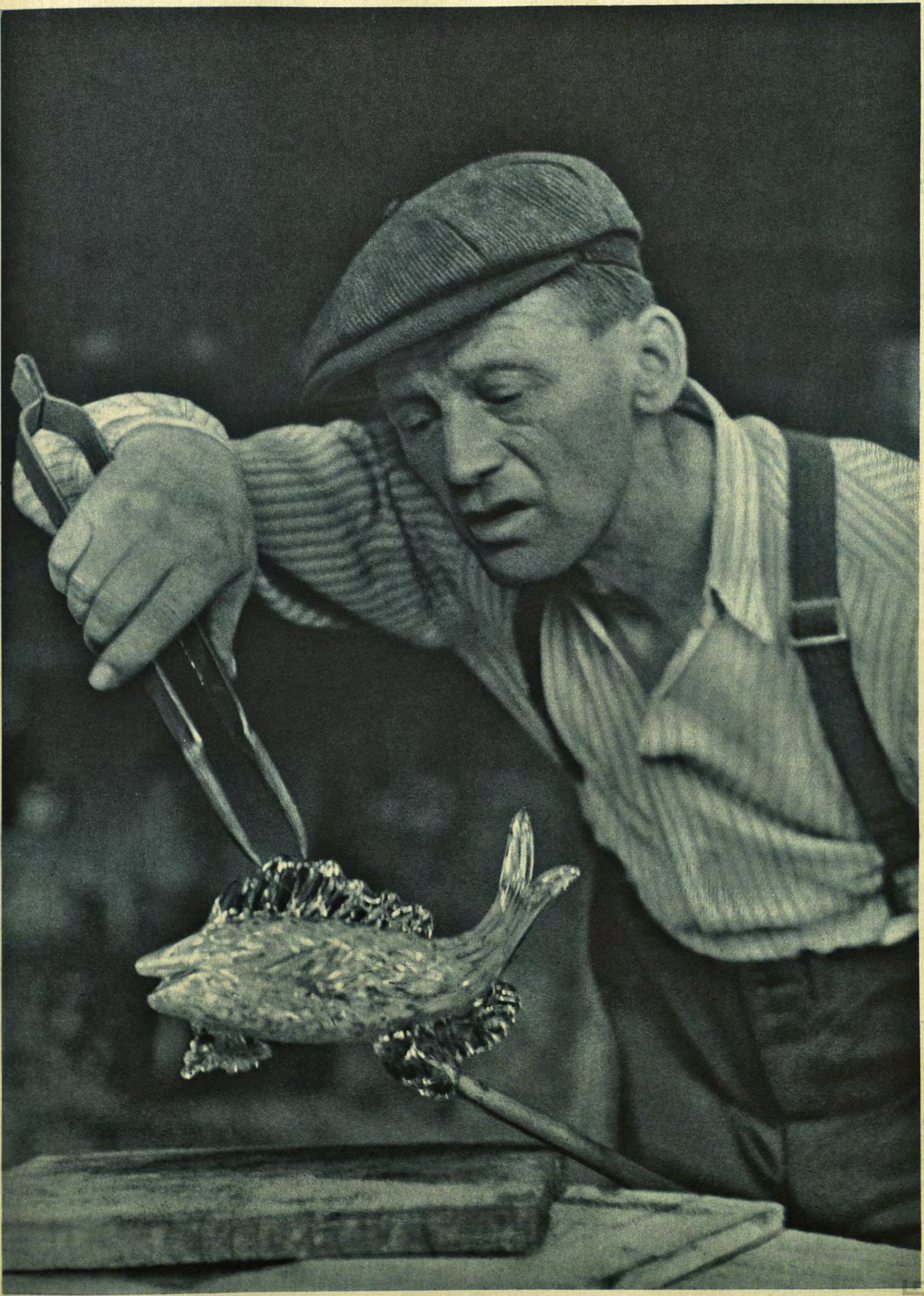
343. *Prof. Karel Štipl: Cut and Engraved Crystal-Glass. Vase for J. V. Stalin on his 70th Birthday. Executed in the School of Arts and Crafts, Prague.*



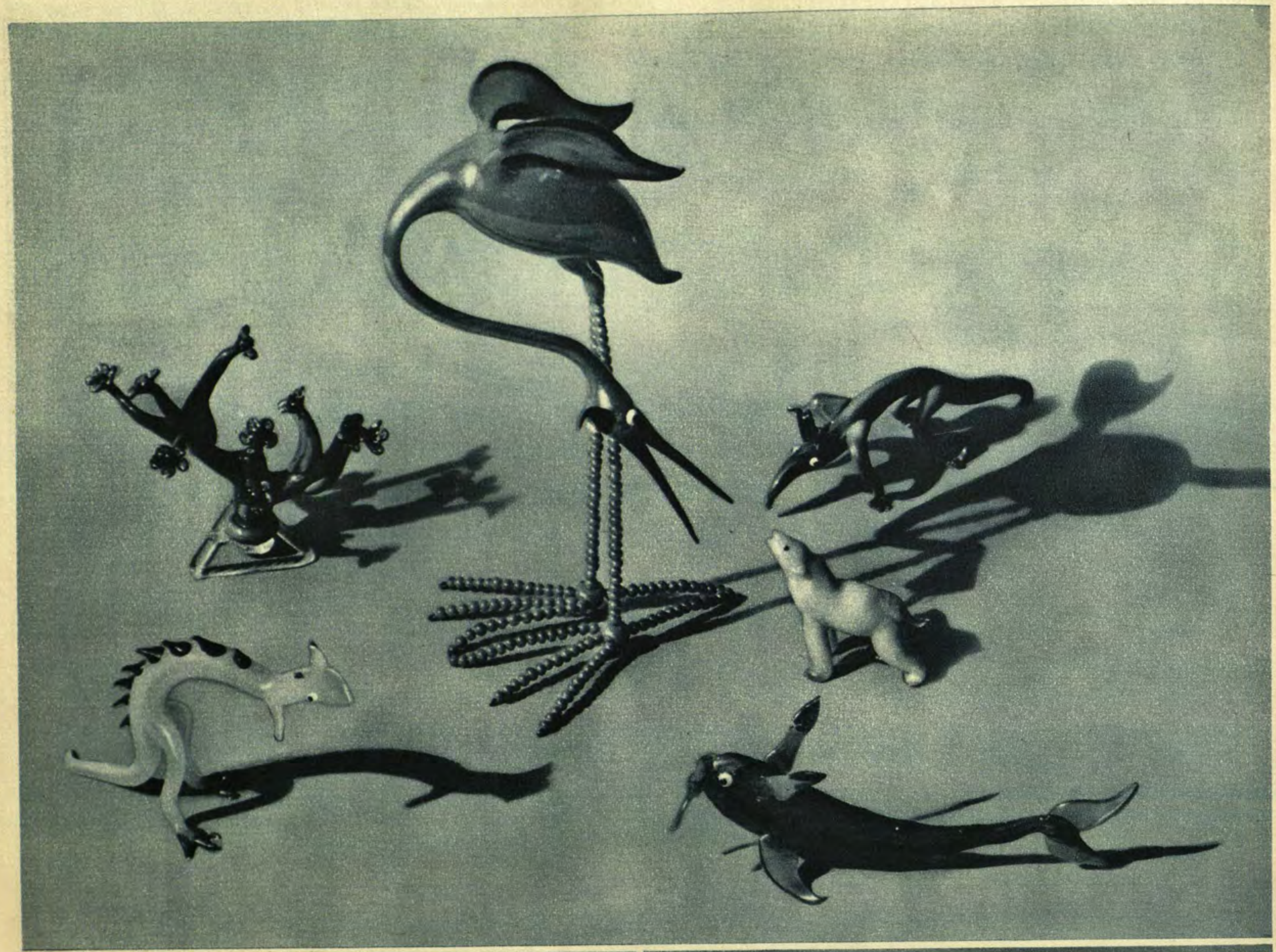
344. *Josef Soukup: "Theatre and Music". Cut Vase, 1943. Executed in Prof. Štipl's School.*

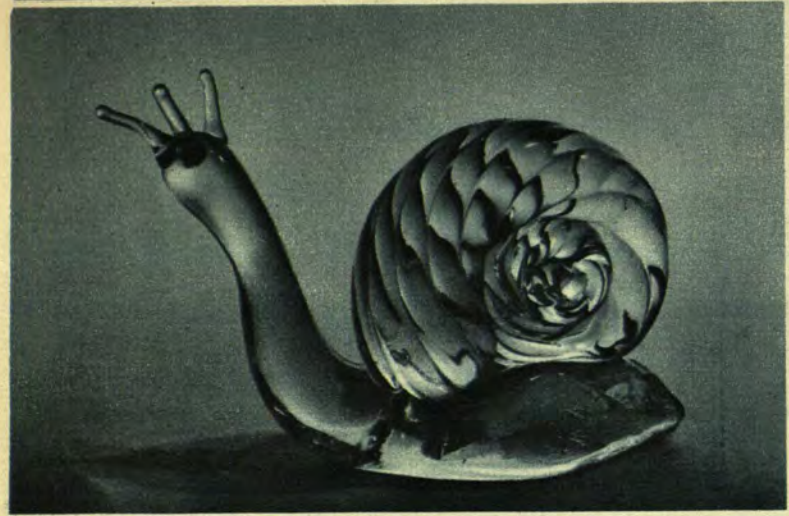


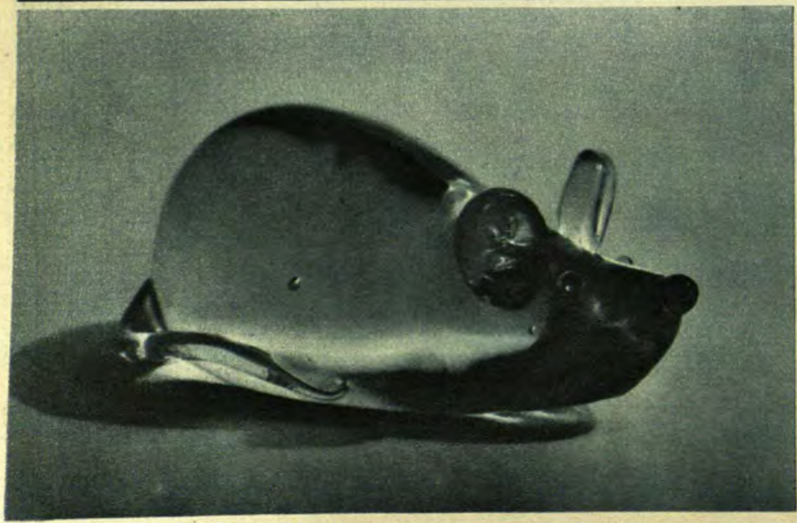
345.—347. Zdenka Braunerová: Small Animals and Vessel, Blown, Painted Glass. 1925. Photo: ÚLUV, Prague.

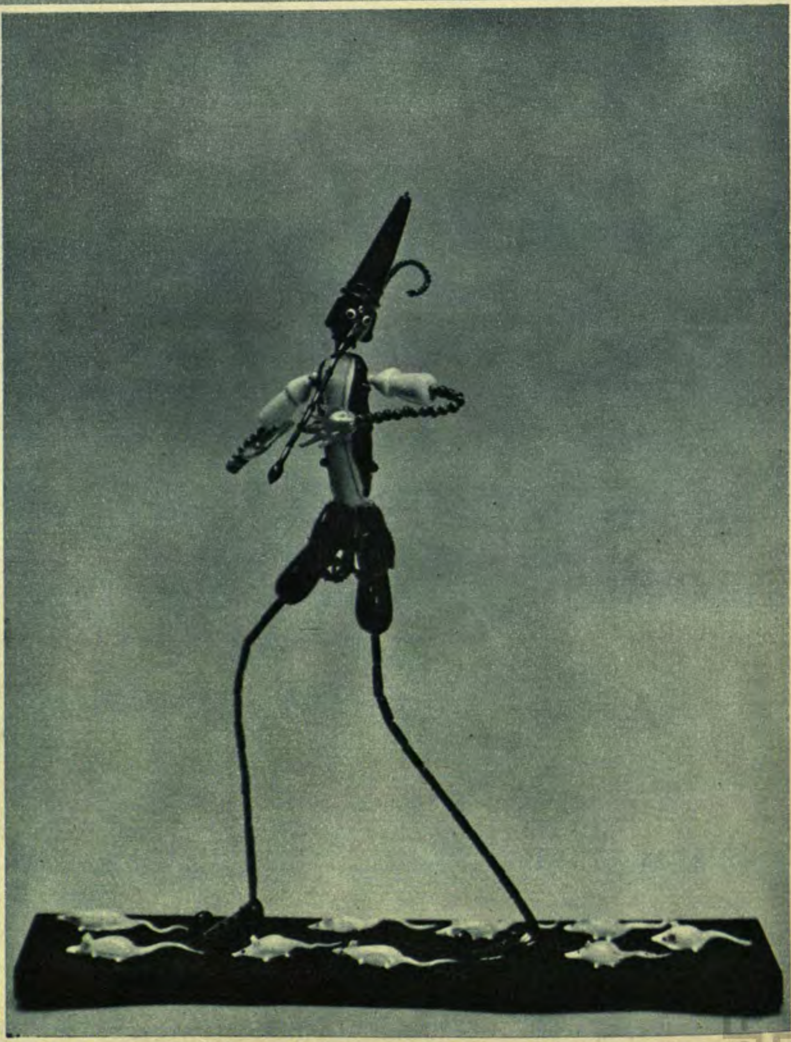


348. *Master Emanuel Beránek Shaping the Scales of a Fish in his Glass-Workshop at Škrdlovice. Photo: Radimský, ÚLUV, Prague.*



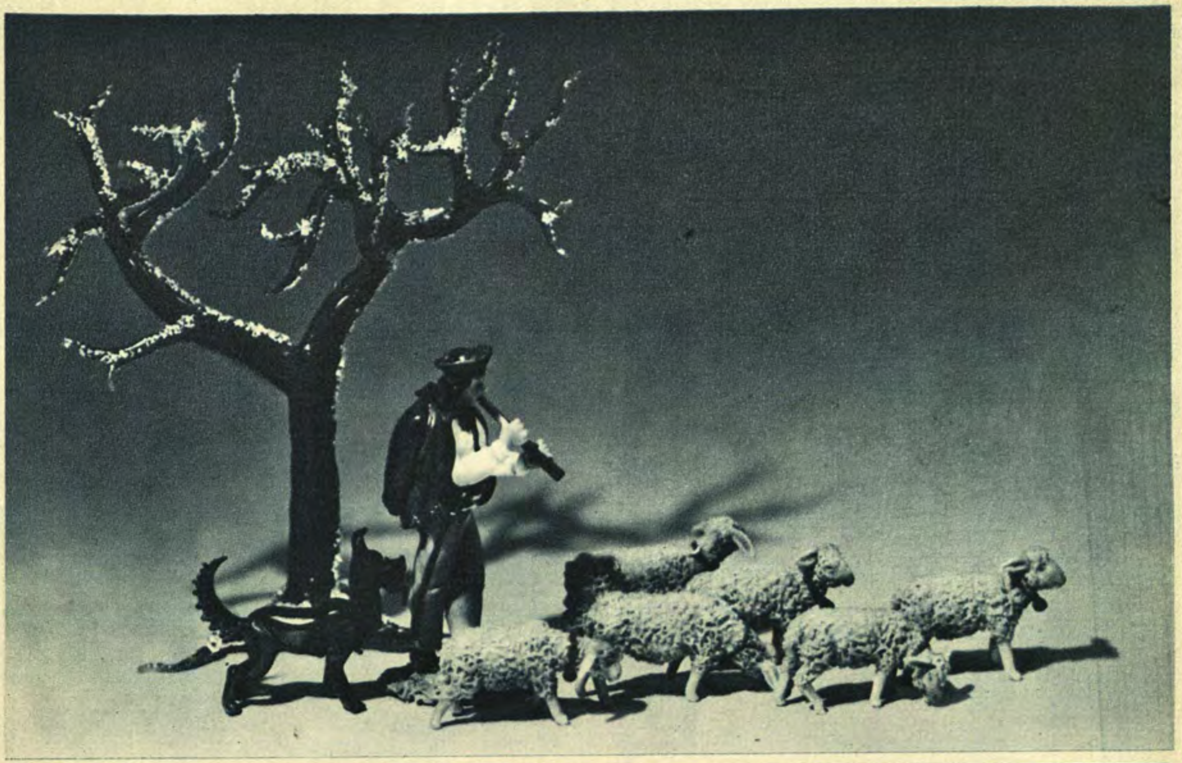




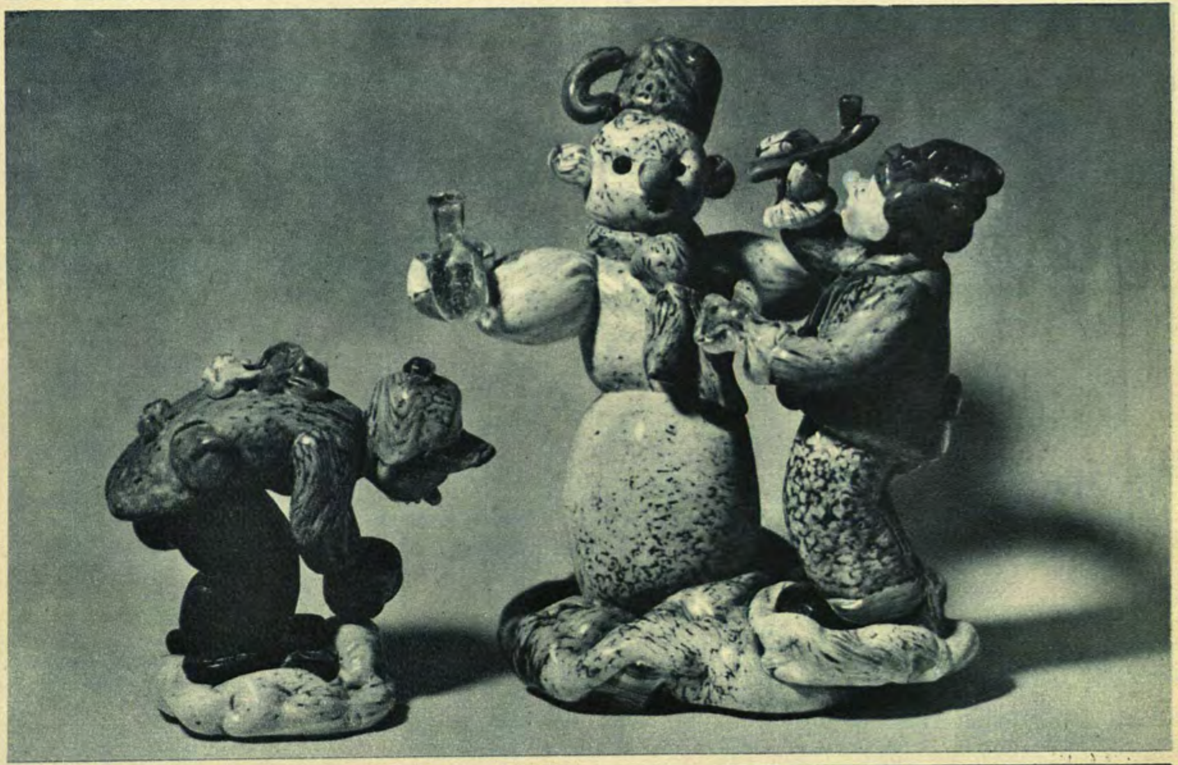


349.—350. Prof. J. Brychta: Glass Figures and "The Pied Piper". State Technical School of Glass-Making, Železný Brod. 1926.
351.—352. Milena Kytková-Roubíčková: Glass Paper-Weights. Photo: V. Rozegnal, Prague.

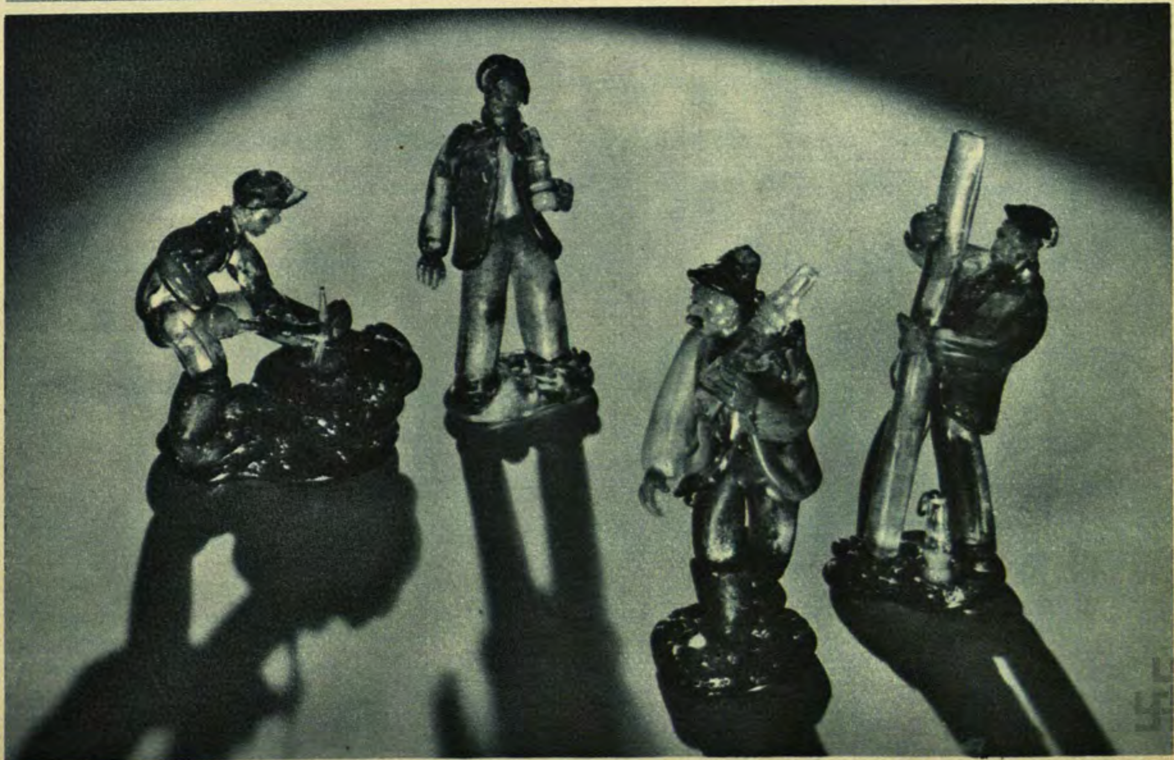
353. Prof. Jaroslav Brychta: "The Shepherd". Executed in Glass by M. Klinger. Figures from the Film "The Glass-Suite". State Technical School of Glass-Making, Železný Brod. 1946.

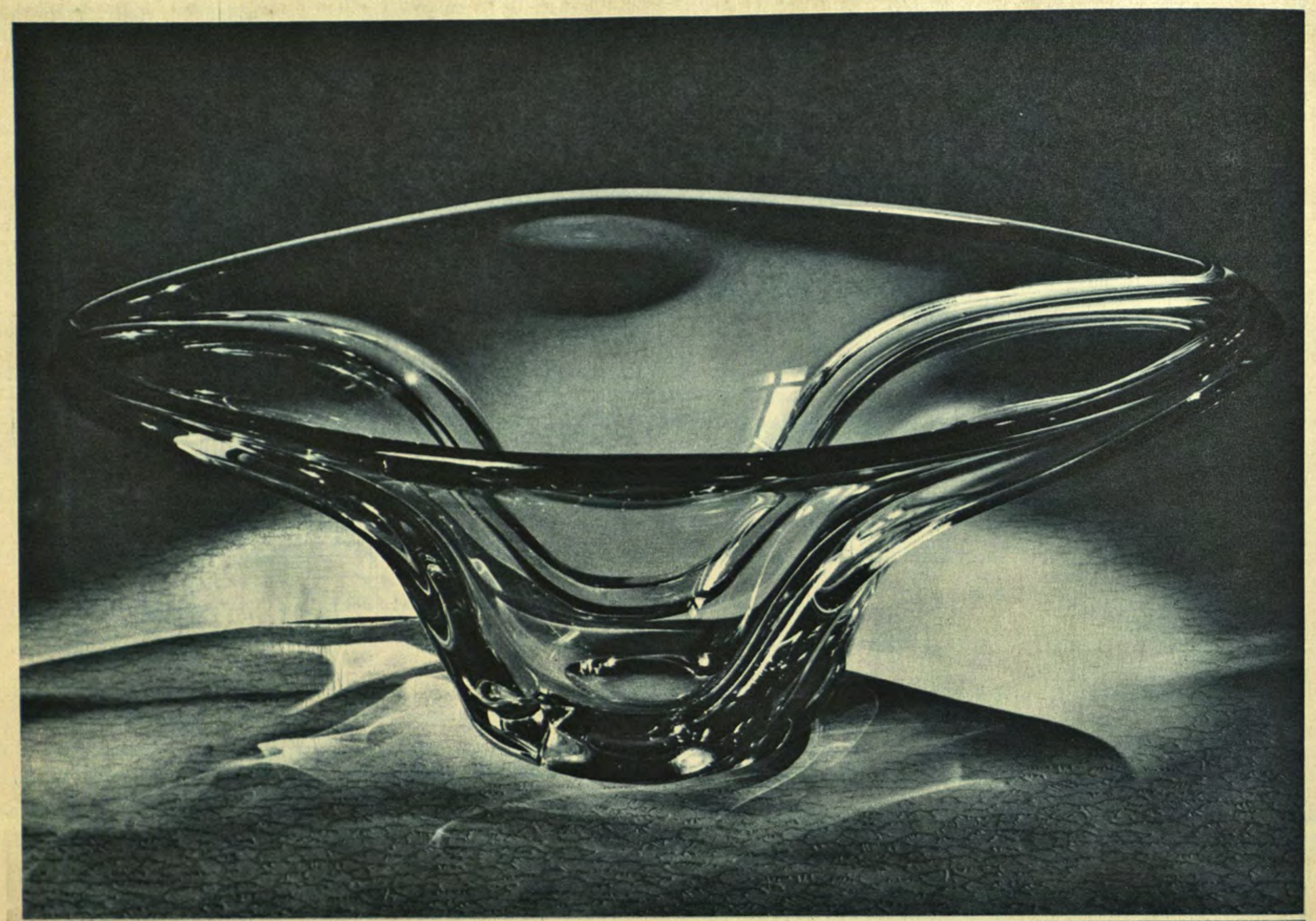


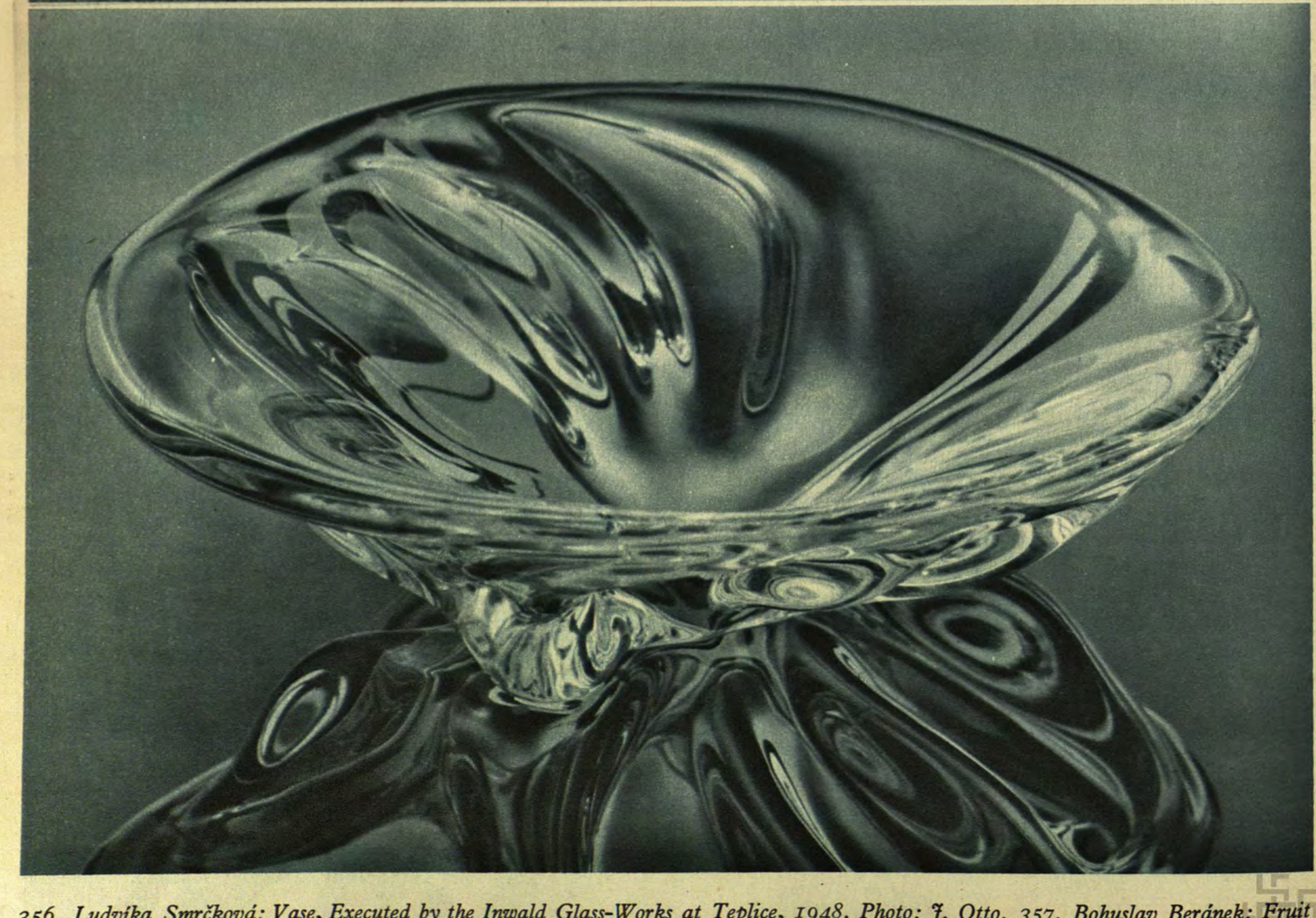
354. Prof. J. Brychta: Glass-Figures. Made by M. Klinger. State Technical School of Glass-Making, Železný Brod. 1946.



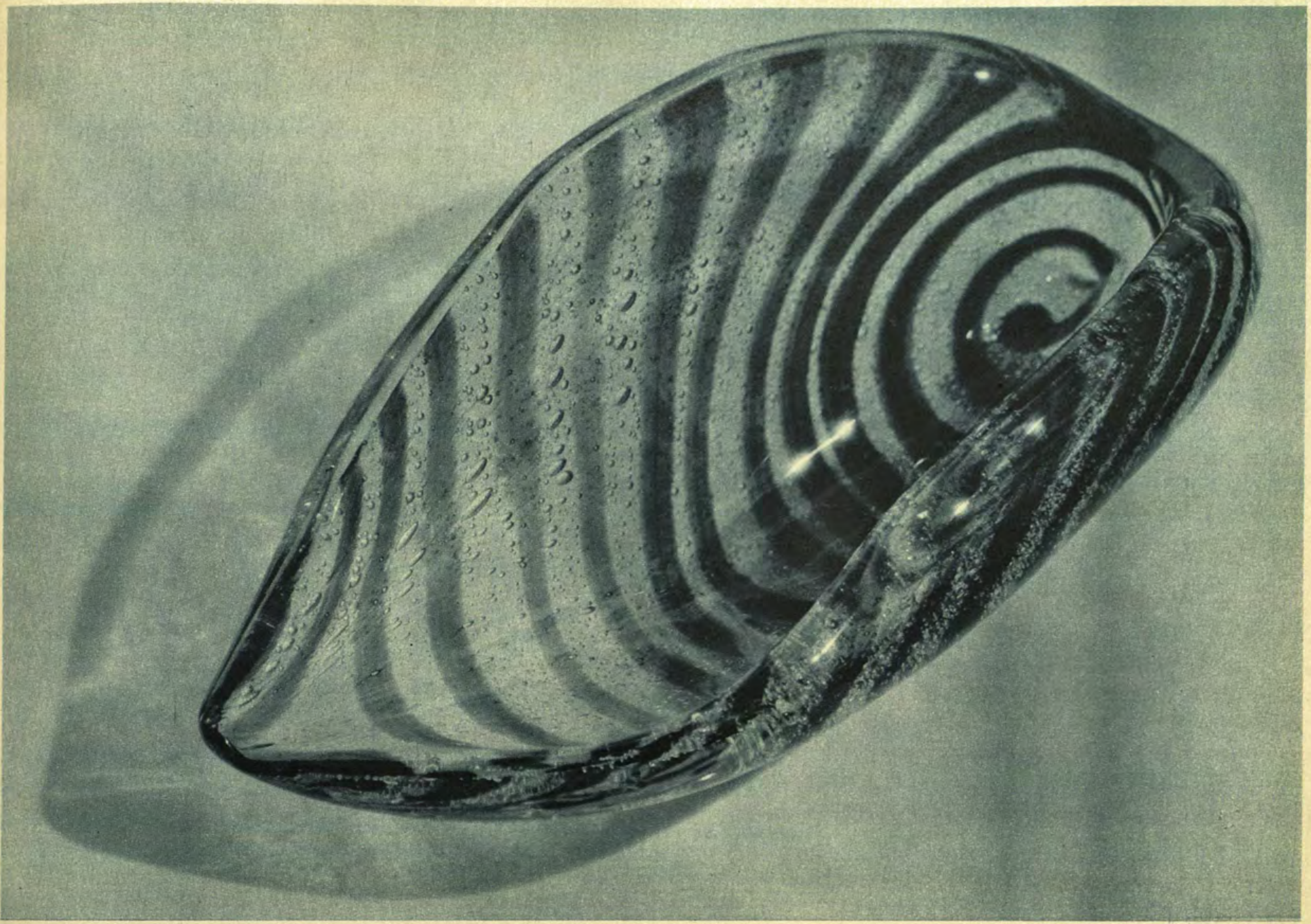
355. M. Klinger: Glass-Figures Made of Transparent Coloured Glass. Produced by the Železnobrod Glass-Works. 1951. Photo: J. Brok, Prague.

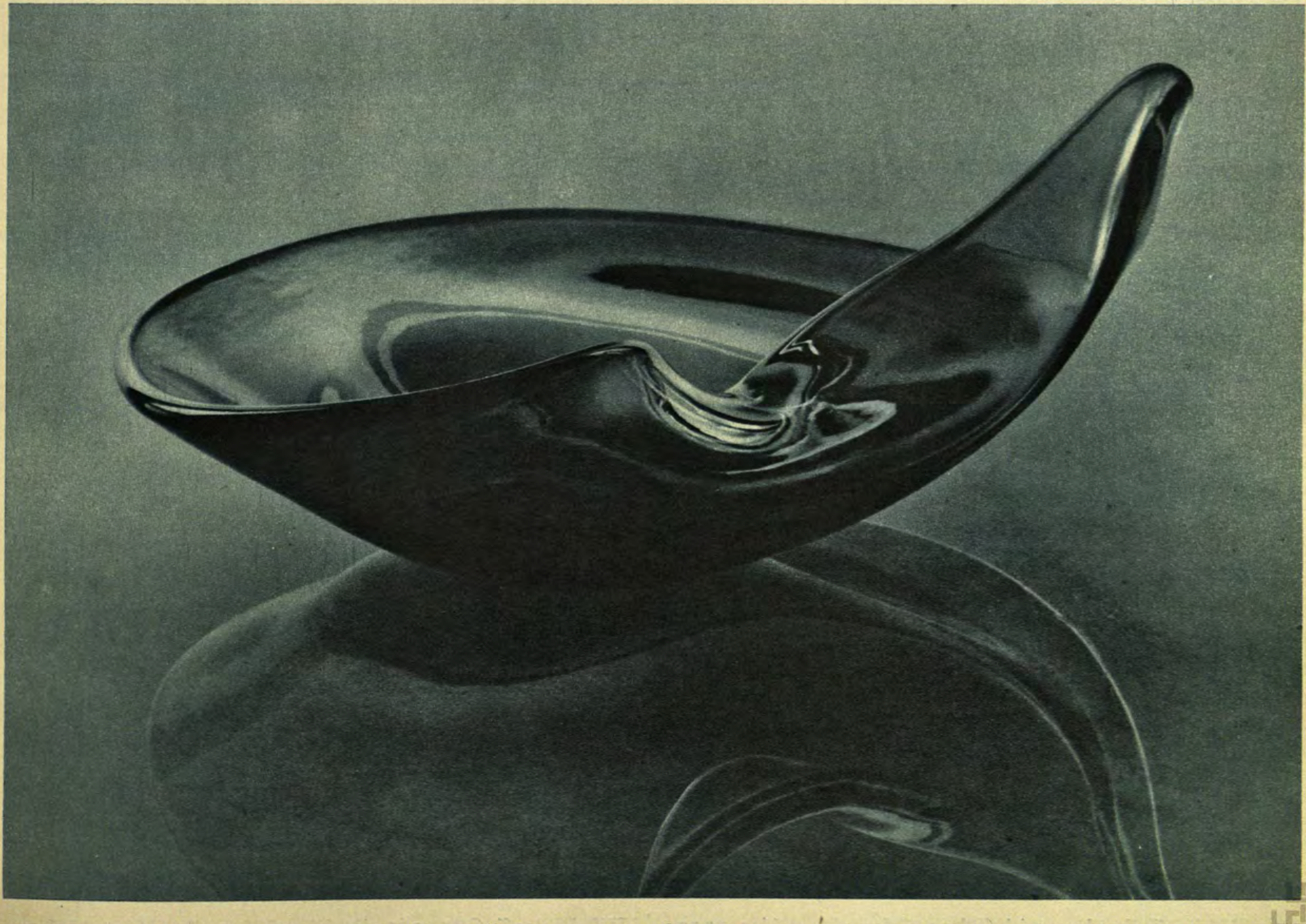




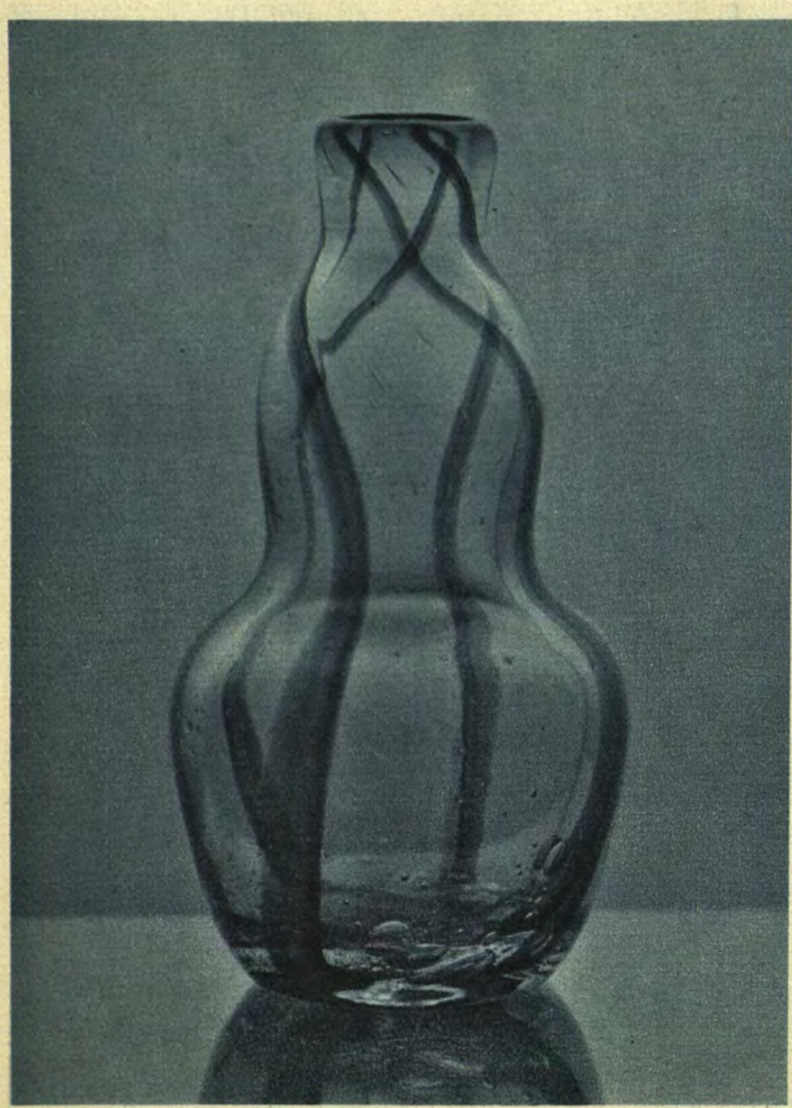


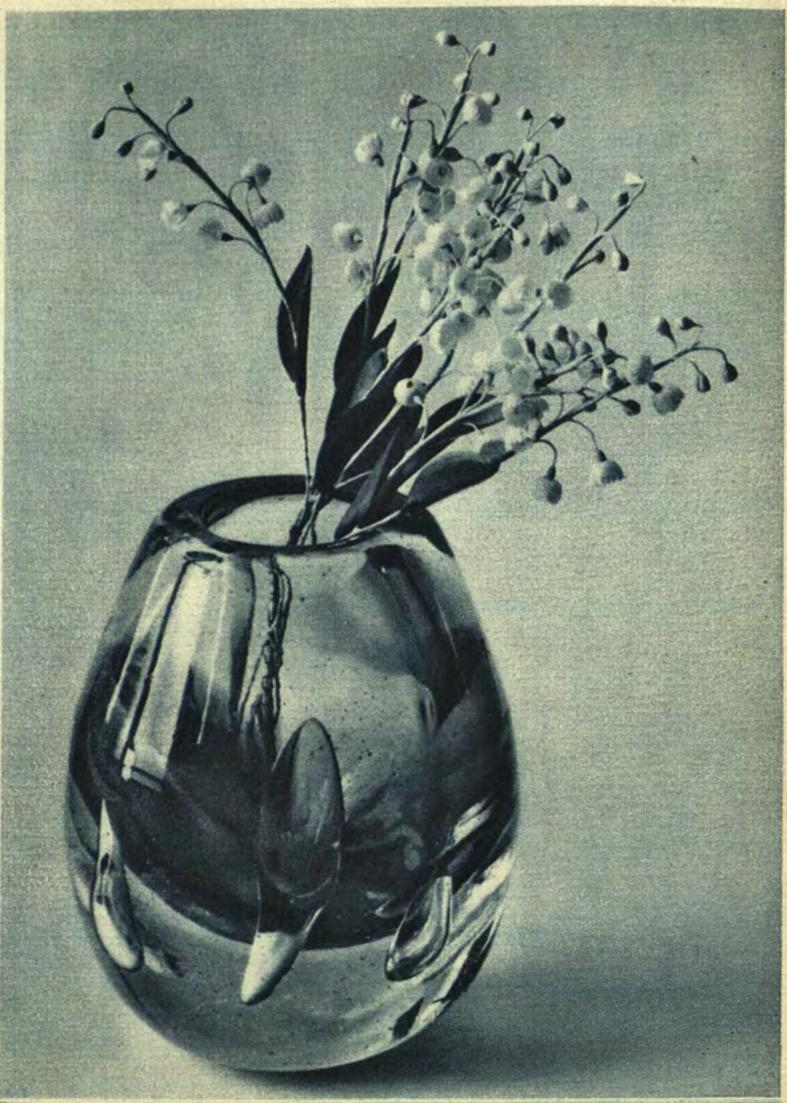
356. Ludvíka Smrčková: Vase, Executed by the Inwald Glass-Works at Teplice, 1948. Photo: J. Otto. 357. Bohuslav Beránek: Fruit Dish of Clear Rosalin Glass with Decorations, Shaped by Hand. Škrdlovice, 1950. ÚLUV, Photo: J. Otto.

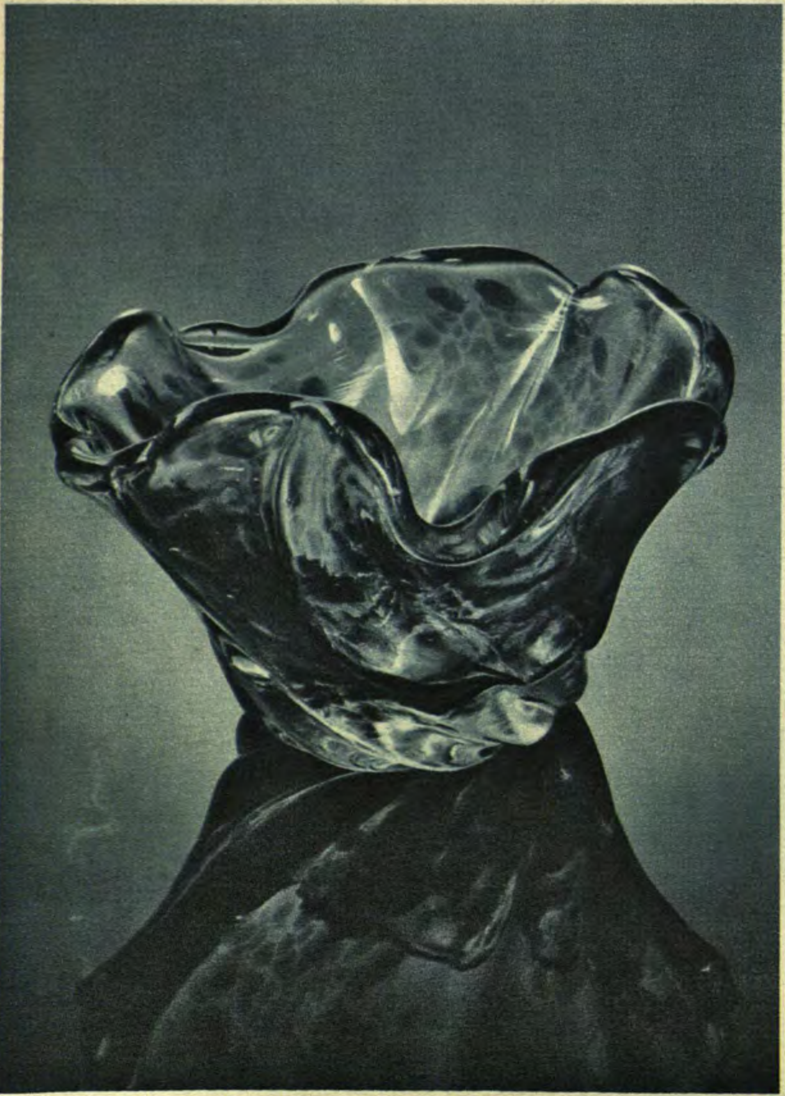


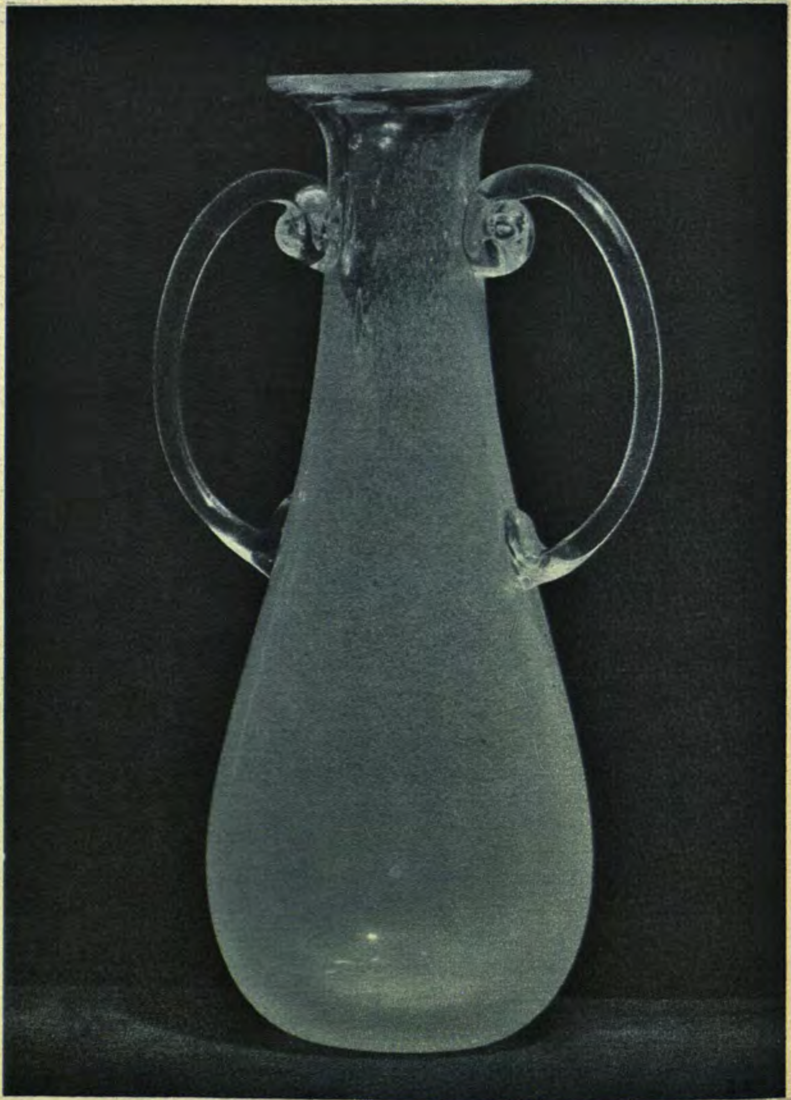


358. Milena Velíšková: Ash-Tray in Shell Shape. Škrdlovice 1951. ÚLUV, Photo: J. Otto. 359. Bohuslav Beránek: Ash-Tray. Topaz-Brown Colour. Škrdlovice. ÚLUV, Photo: J. Otto.

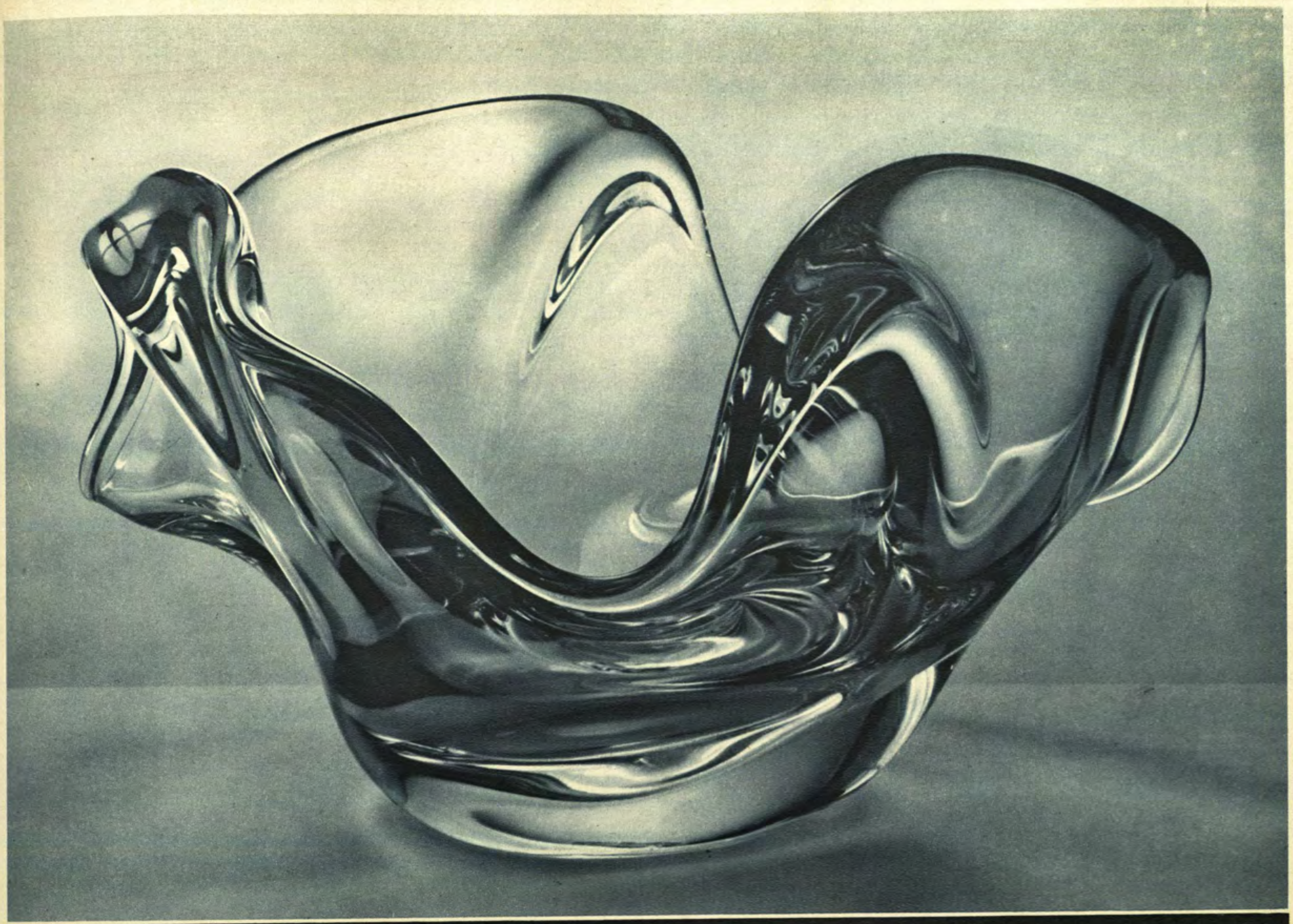


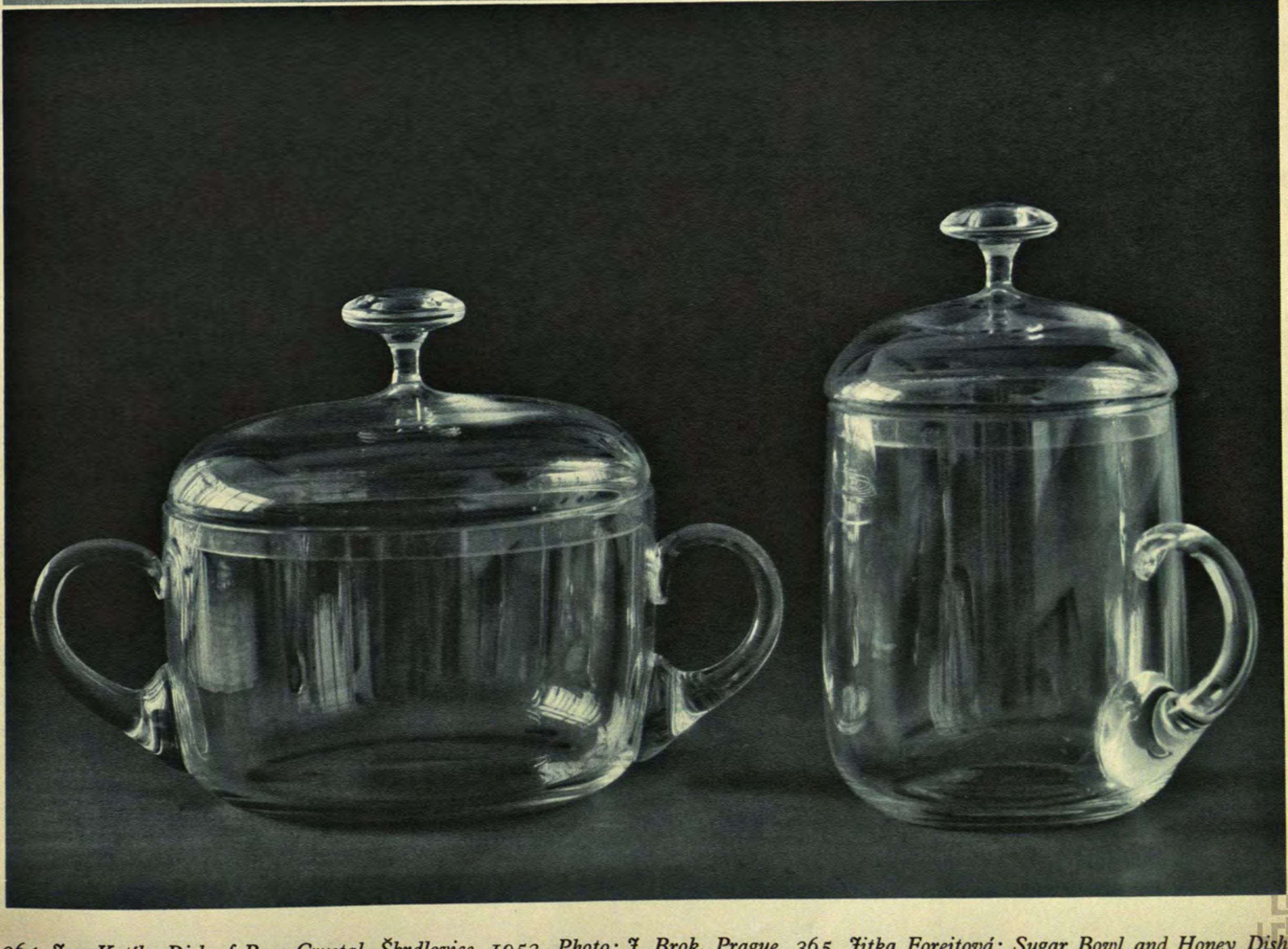




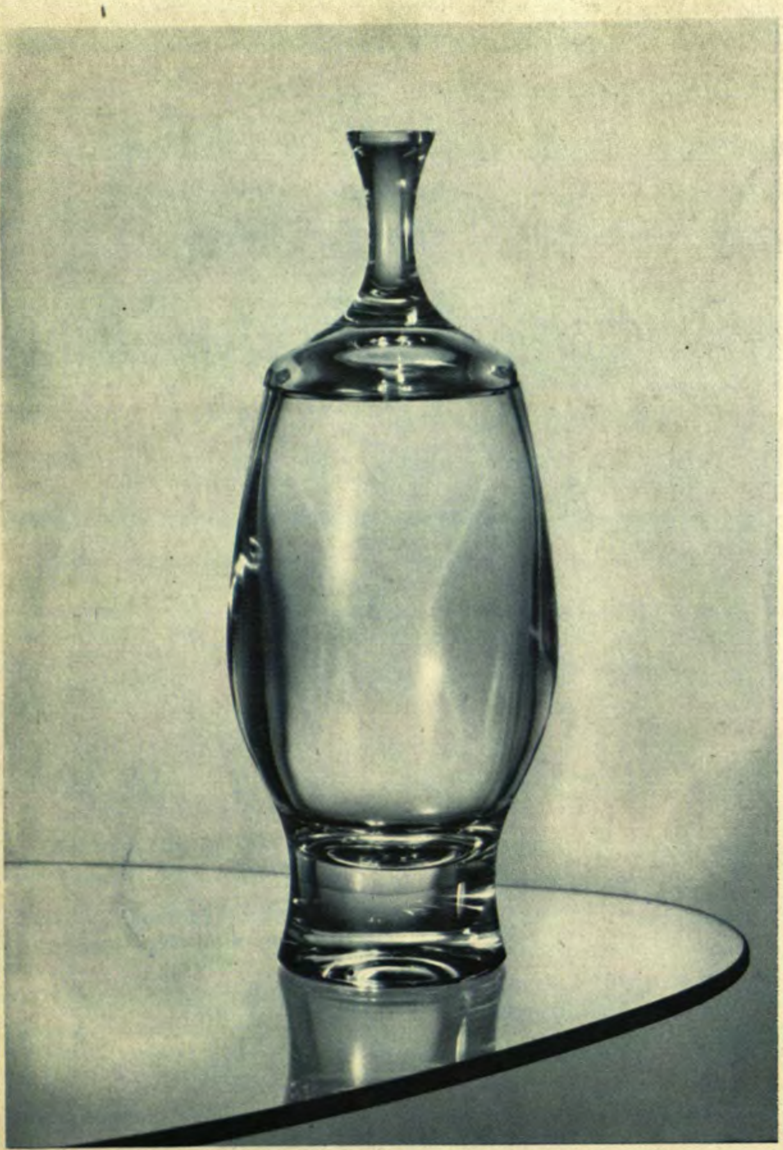


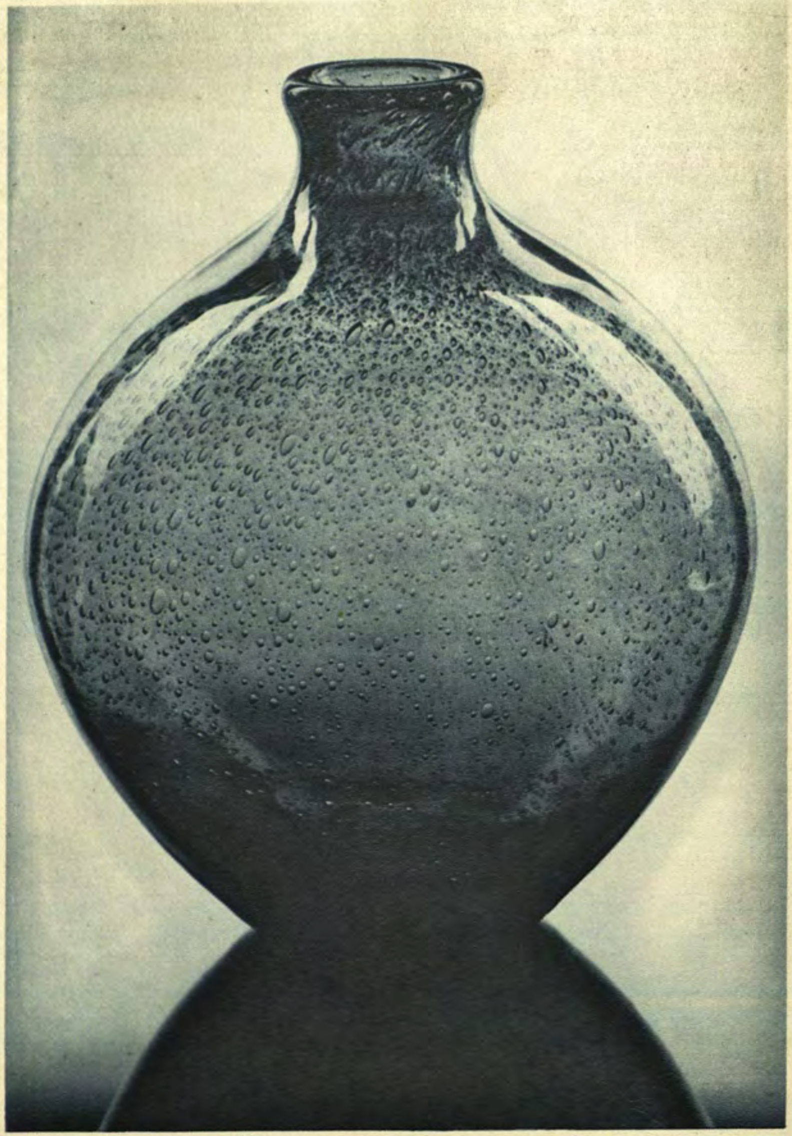
360. Václav Trčka: Vase with Oblong, Coloured Hatching. 1950. ÚLUV. Photo: J. Otto. 361. Prof. Josef Hospodka: Vase with Large Bubbles with a Layer of Ruby. Made by "Artistic Glass" N. E. Nový Bor. 362. Prof. J. Hospodka: Jardiniere. (Same Producers.) 363. Vlasta Lichtágová: Vase. 1951. ÚLUV. Photo: J. Otto.

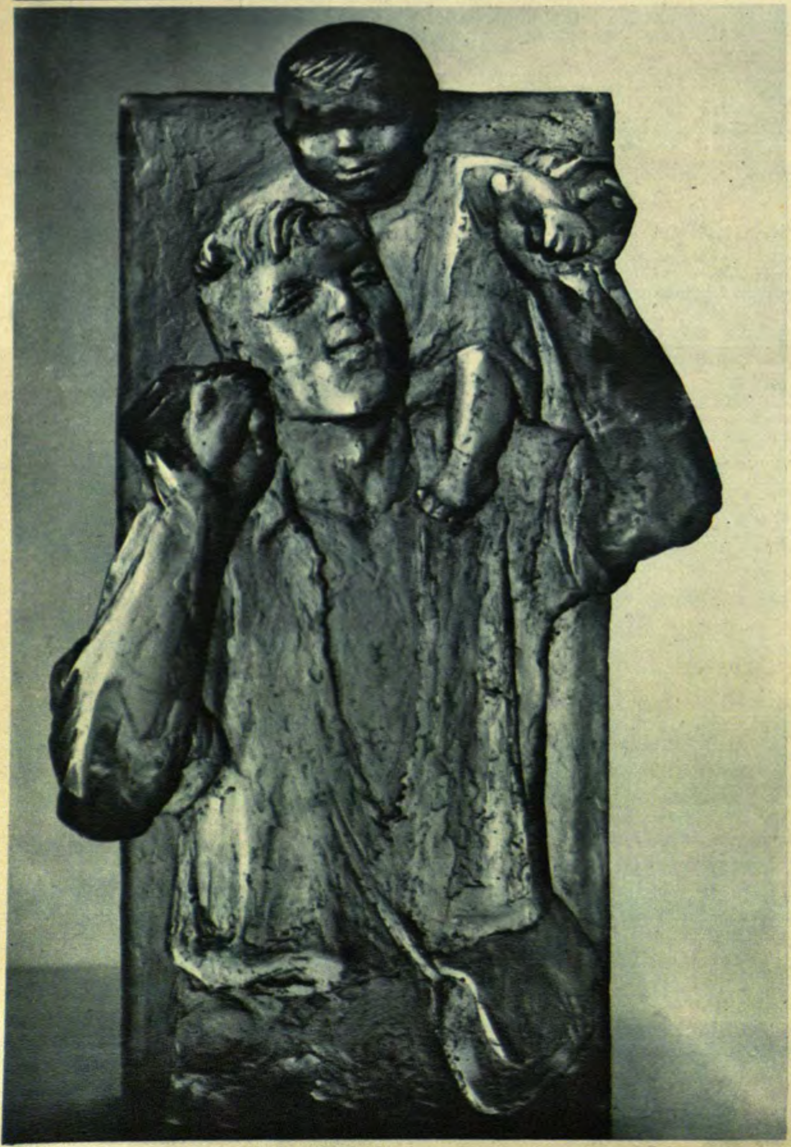


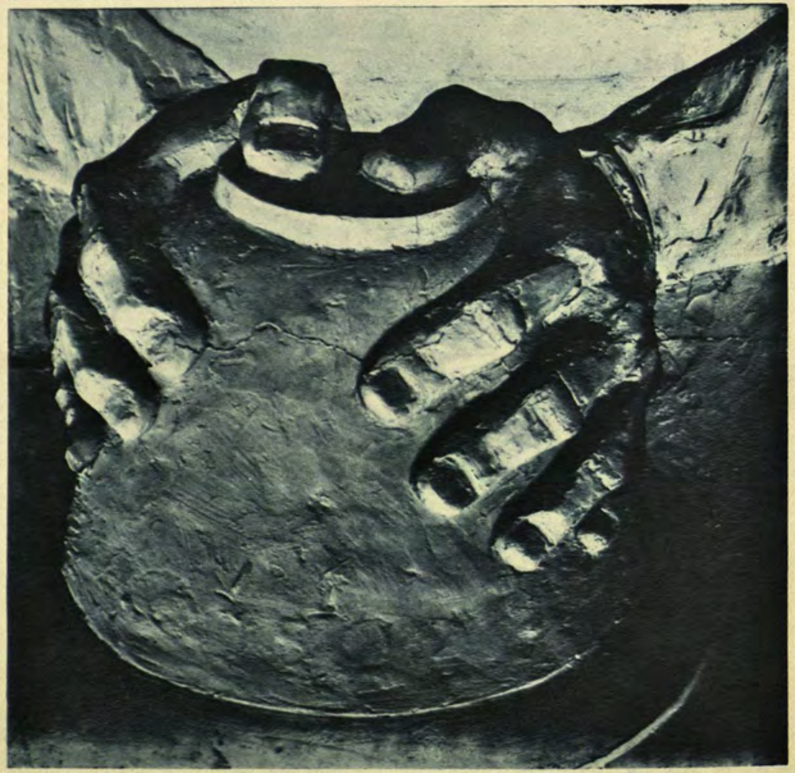


364. Jan Kotík: Dish of Pure Crystal. Škrdlovice, 1953. Photo: J. Brok, Prague. 365. Jitka Forejtová: Sugar Bowl and Honey Dish made of Thin-Walled, Blown Glass. N. E. "Bor Glass" Vetter Works, 1953. Co-operation by V. S. ÚLUV. Photo: J. Otto.

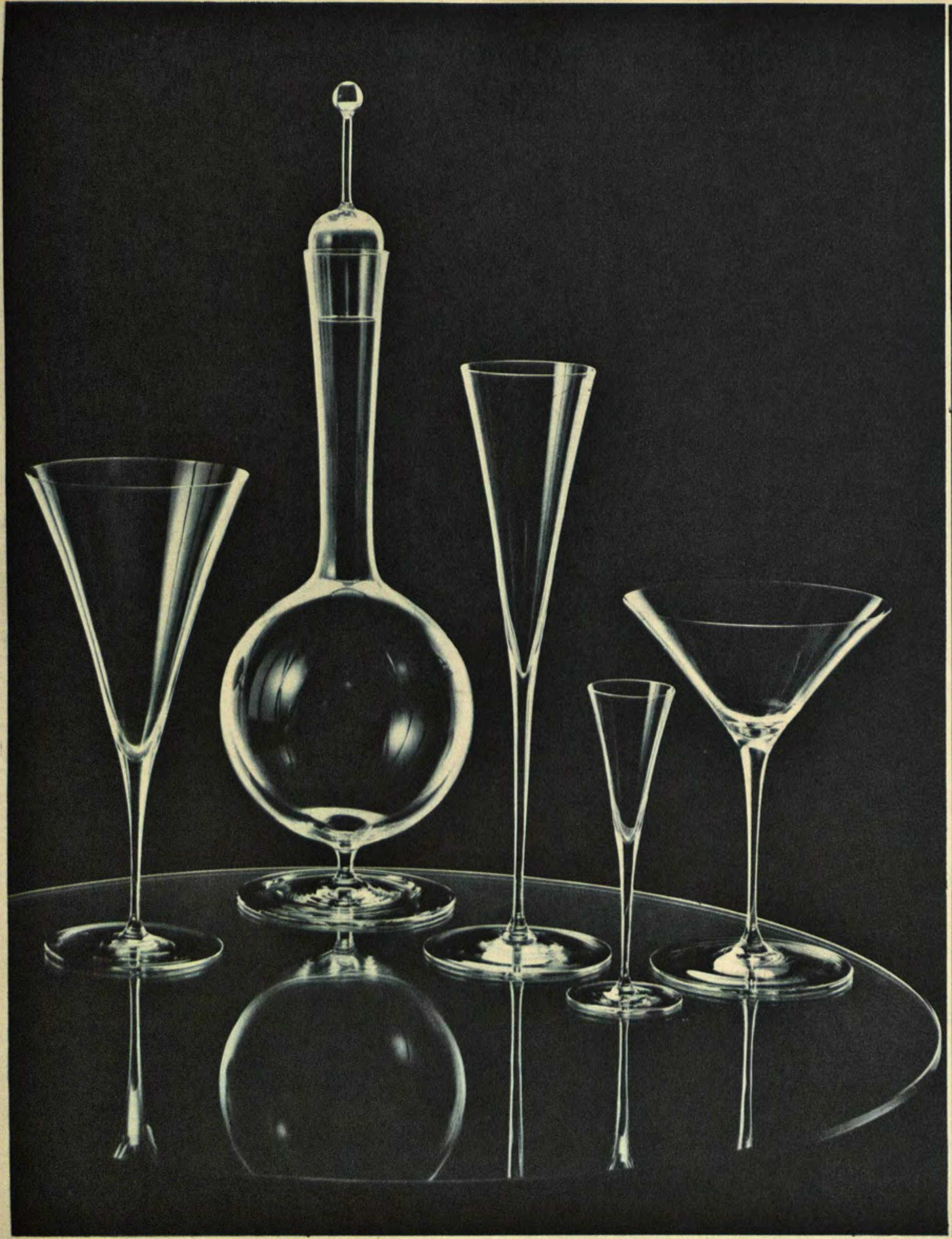




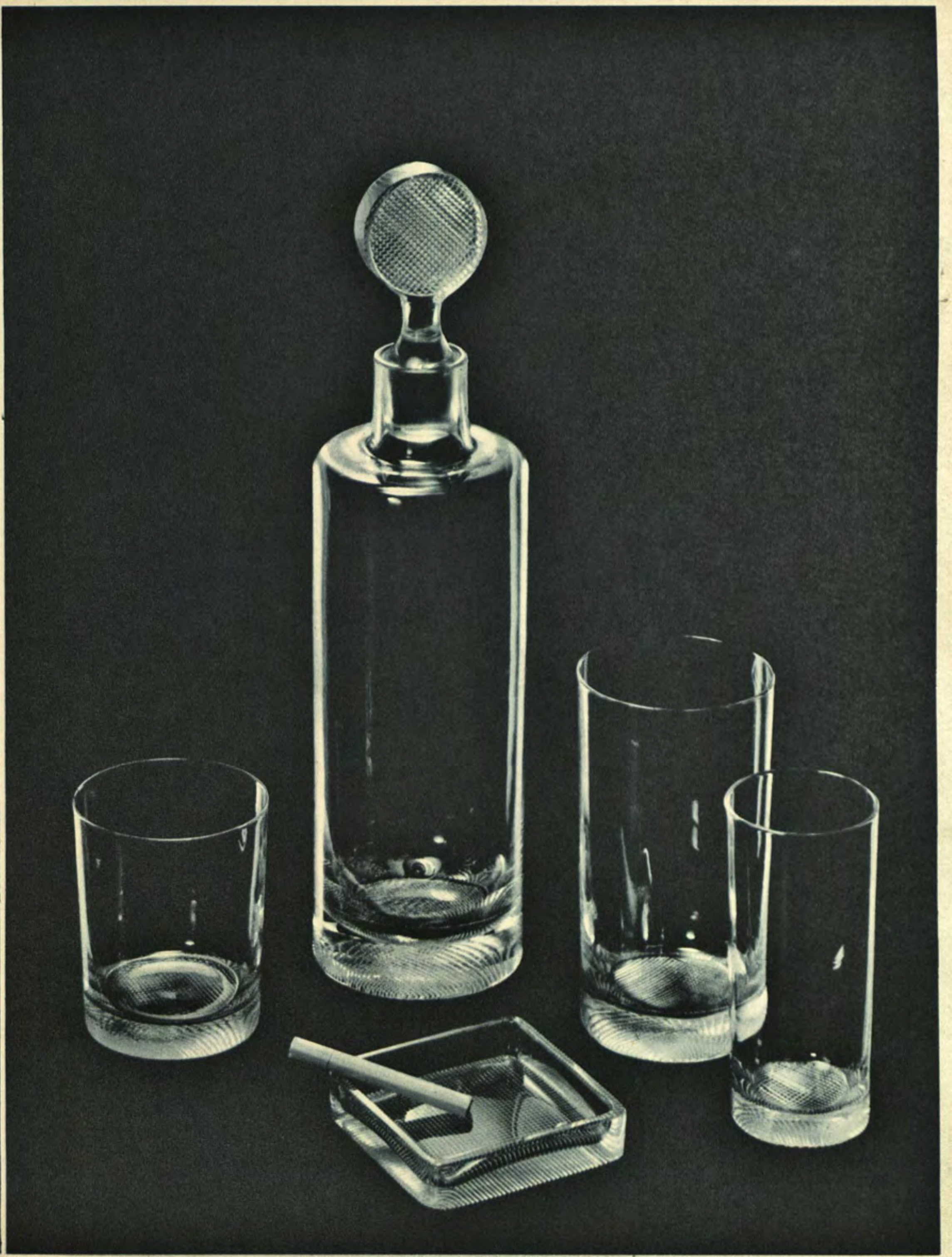




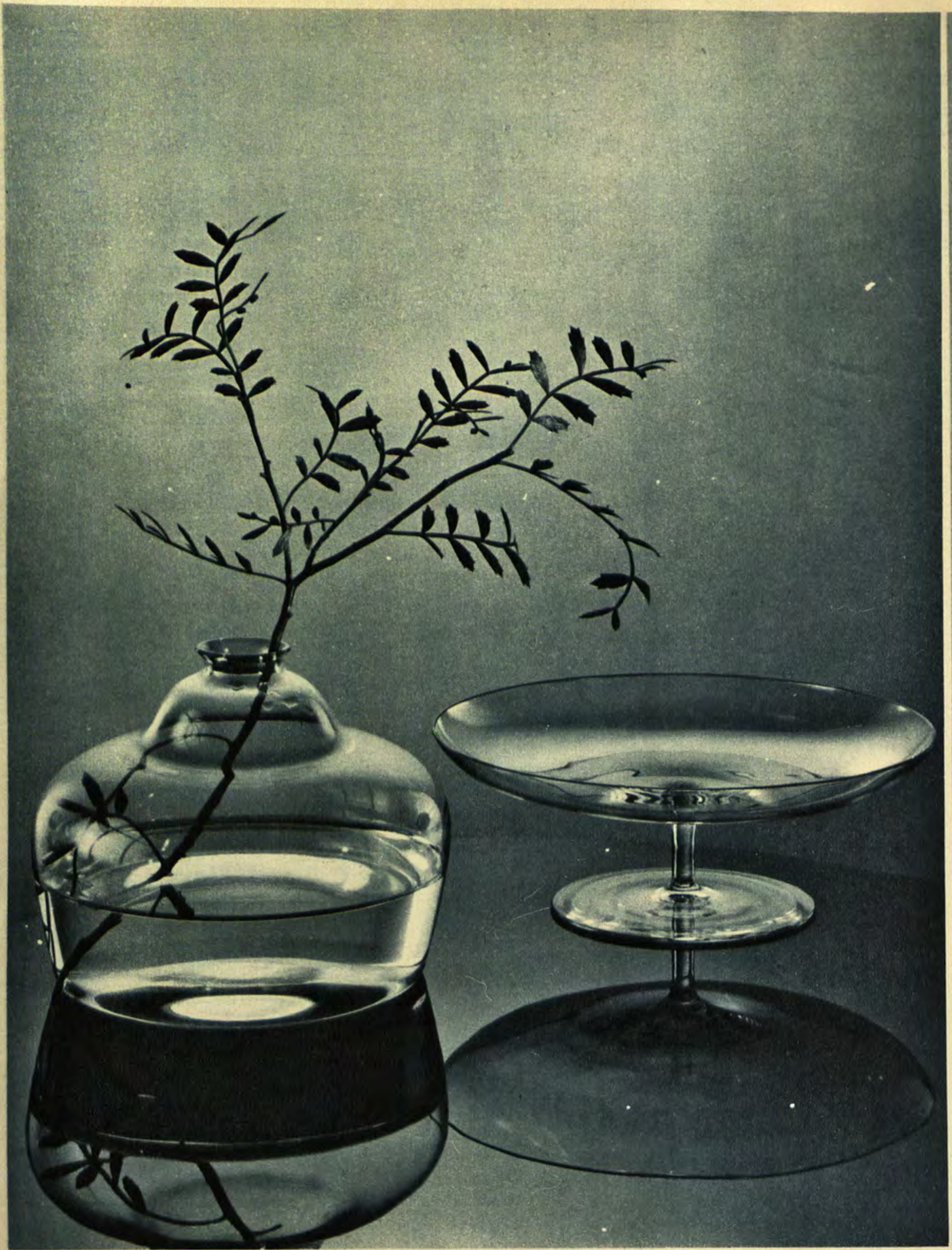
366. František Zemek: Jar of Thick-Walled Glass. Executed by the N. E. Železnobrod Glass-Works. 1951. Photo: J. Brok, Prague. 367. Jan Kotík: Large Pot-Bellied Vase of Dark Topaz-Glass, Decorated with Merging Bubbles within the Glass. Executed by ÚLUV, Škrdlovice. 1951. Photo: J. Otto. 368. J. Zahradníková-Brychtová: "The Father". Moulded Relief of Crystal-Glass. Železný Brod. 369. Jaroslava Zahradníková-Brychtová: "The Hands of the Glass-Cutter". Moulded Relief of Crystal-Glass. Železný Brod.



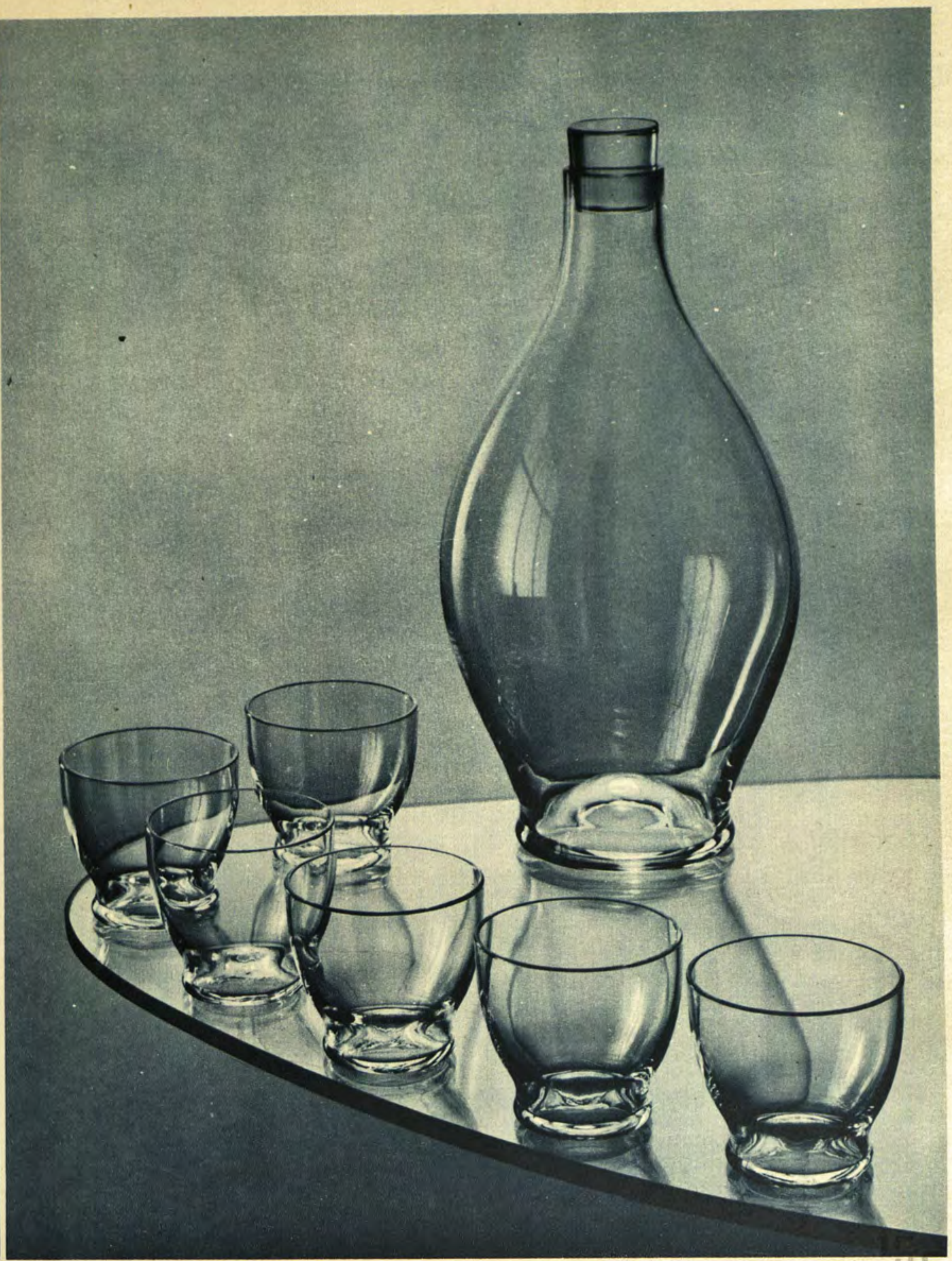
370. Oswald Haerdtel: Wine Service. N. E. "Artistic Glass", Lobmeyr Works, Kam. Šenov. Photo: J. Brok, Prague.



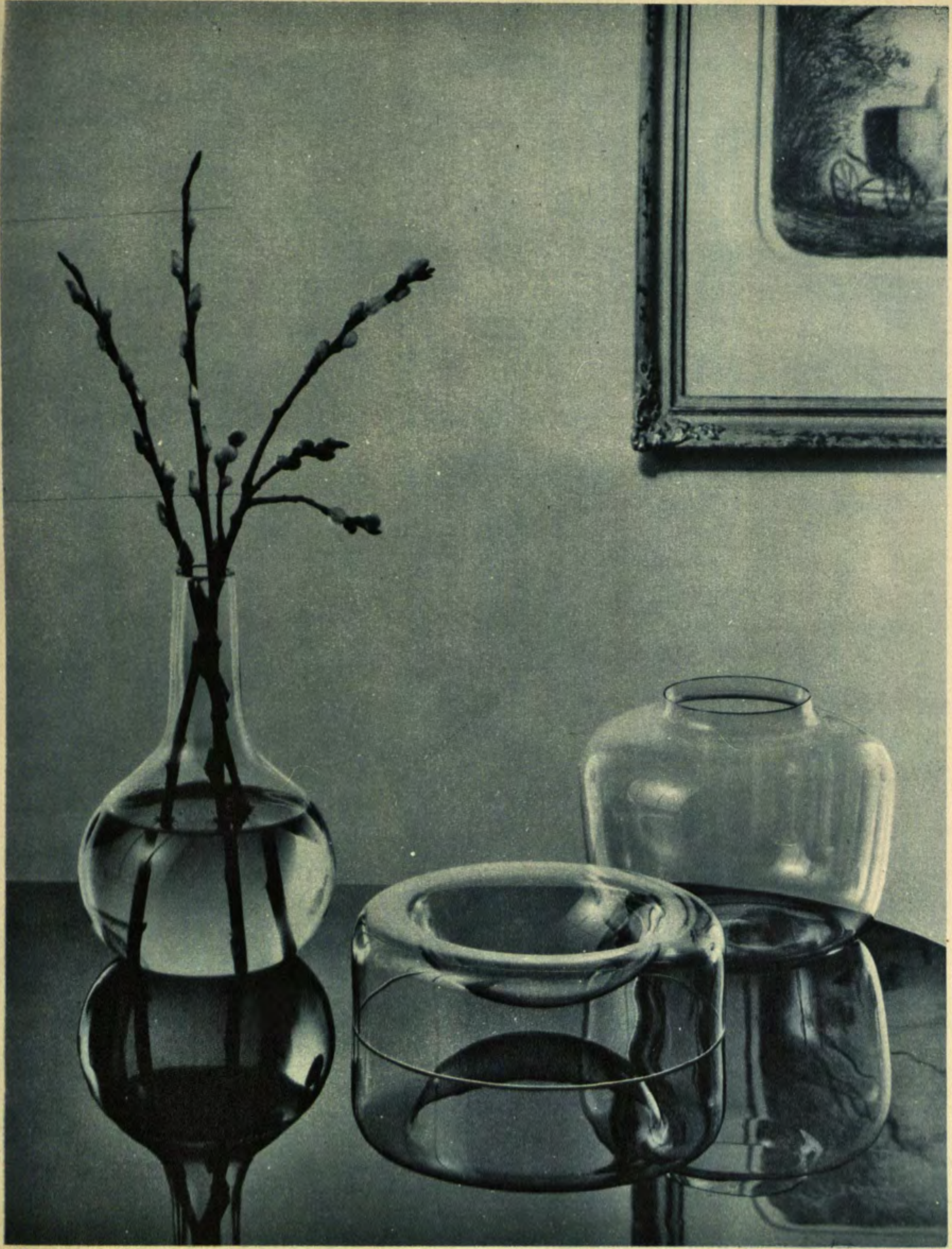
371. Arch. Loos, Vienna: Service. Executed by the "Květen Glass Works" Moravia, for the N. E. "Artistic Glass", Lobmeyr Works, Kam. Šenov. Photo: J. Brok, Prague.



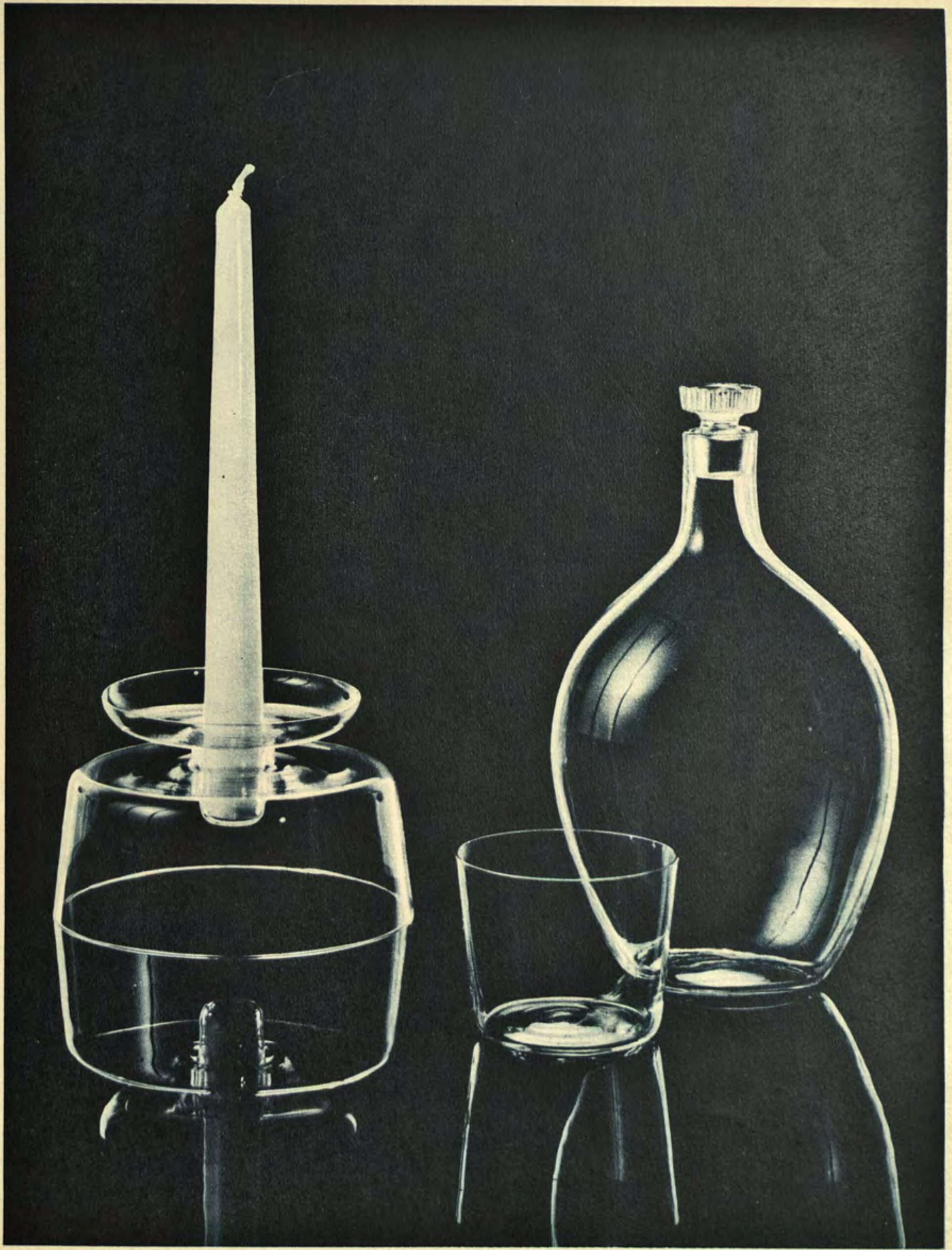
372. *Věra Lišková: Crystal Vase with Dish. Karlovy Vary Glass-Works, N. E., Moser Works. Photo: J. Brok, Prague.*



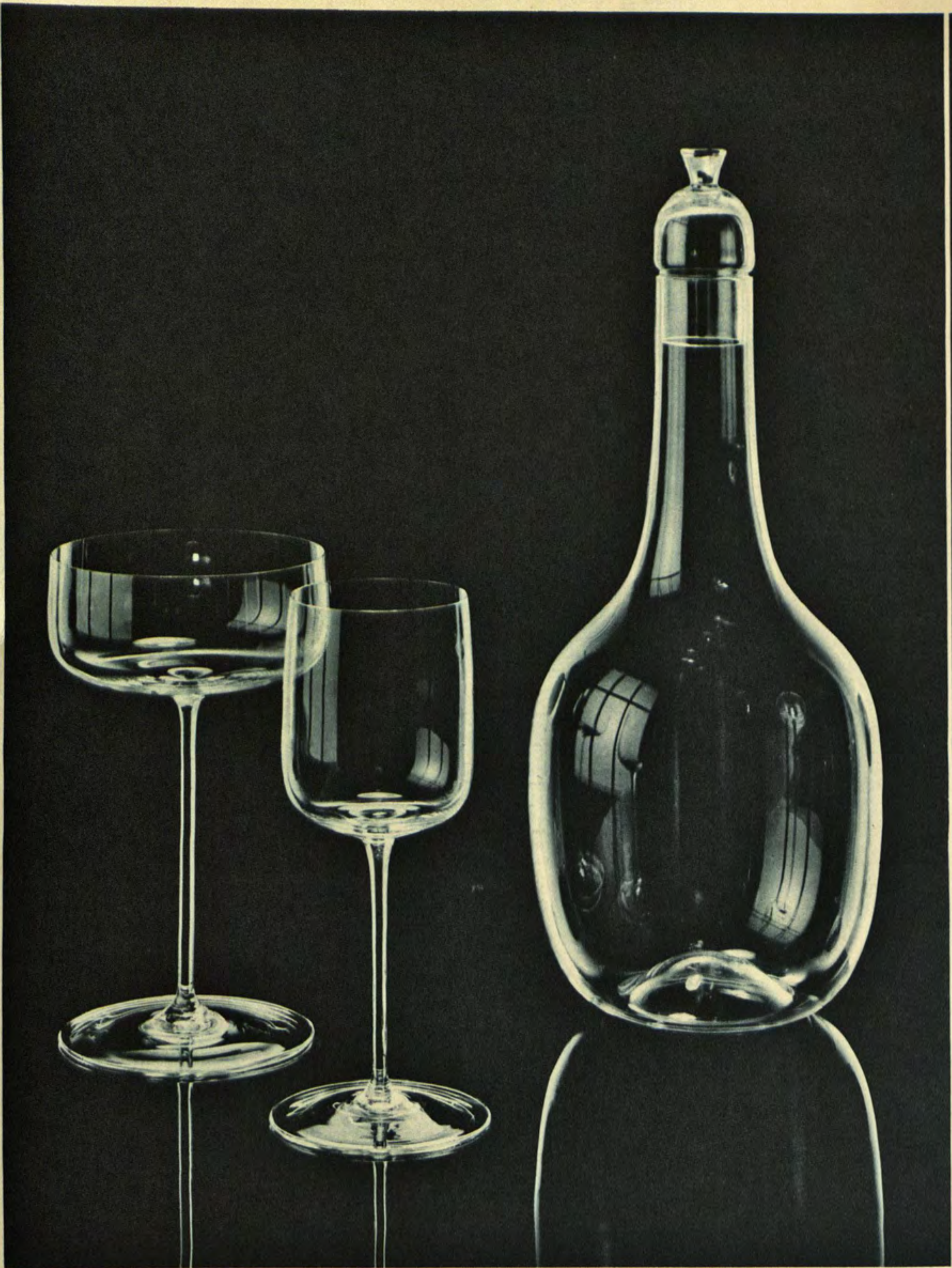
373. *Věra Lišková: Liqueur Service in Crystal-Glass. Karlovy Vary Glass, N. E. Moser Works. Photo: J. Brok, Prague.*



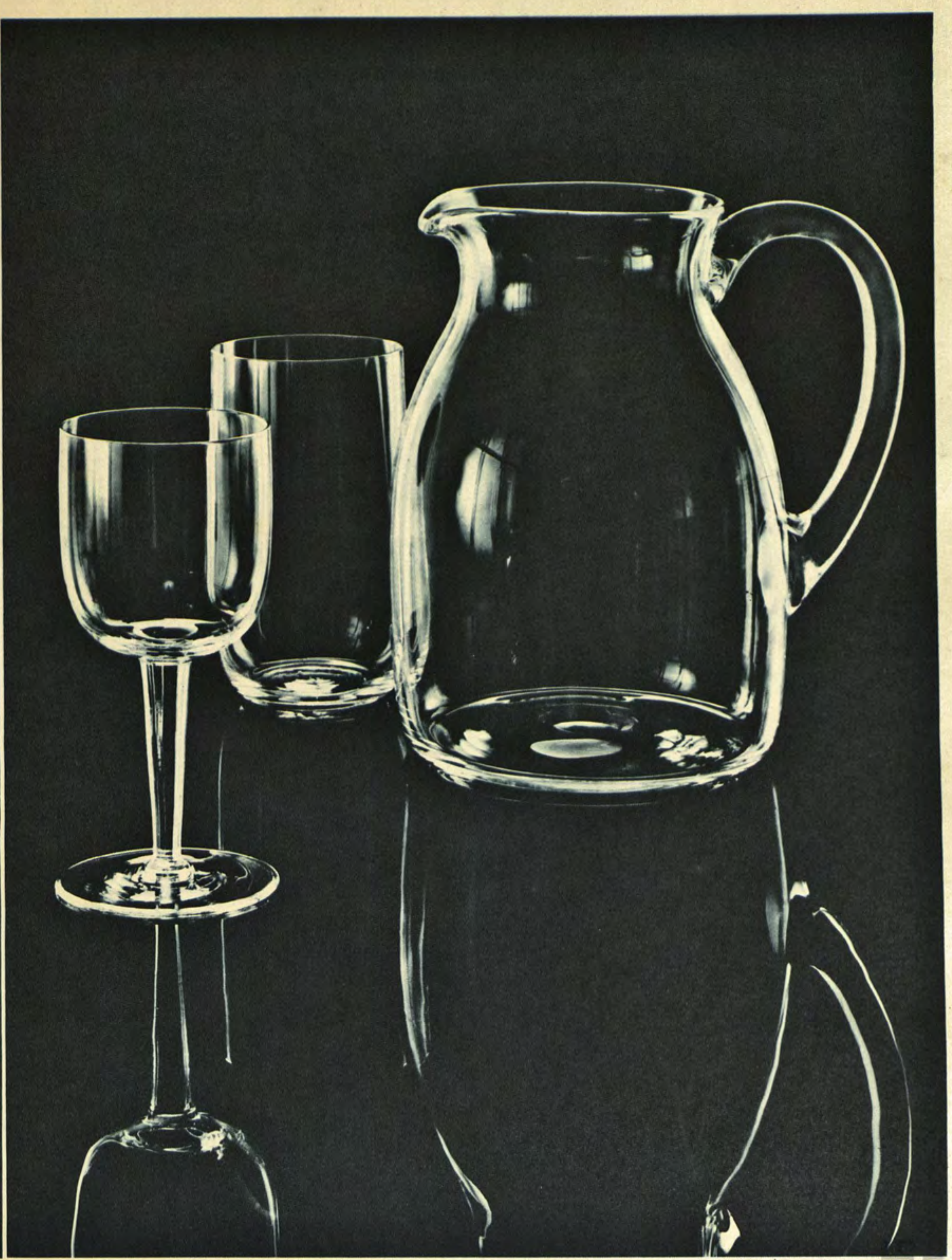
374. Věra Lišková: Vases and Ashtray of Crystal-Glass. "Artistic Glass". N. E. Lobmeyr Works, Kam. Šenov. Photo: J. Brok, Prague.



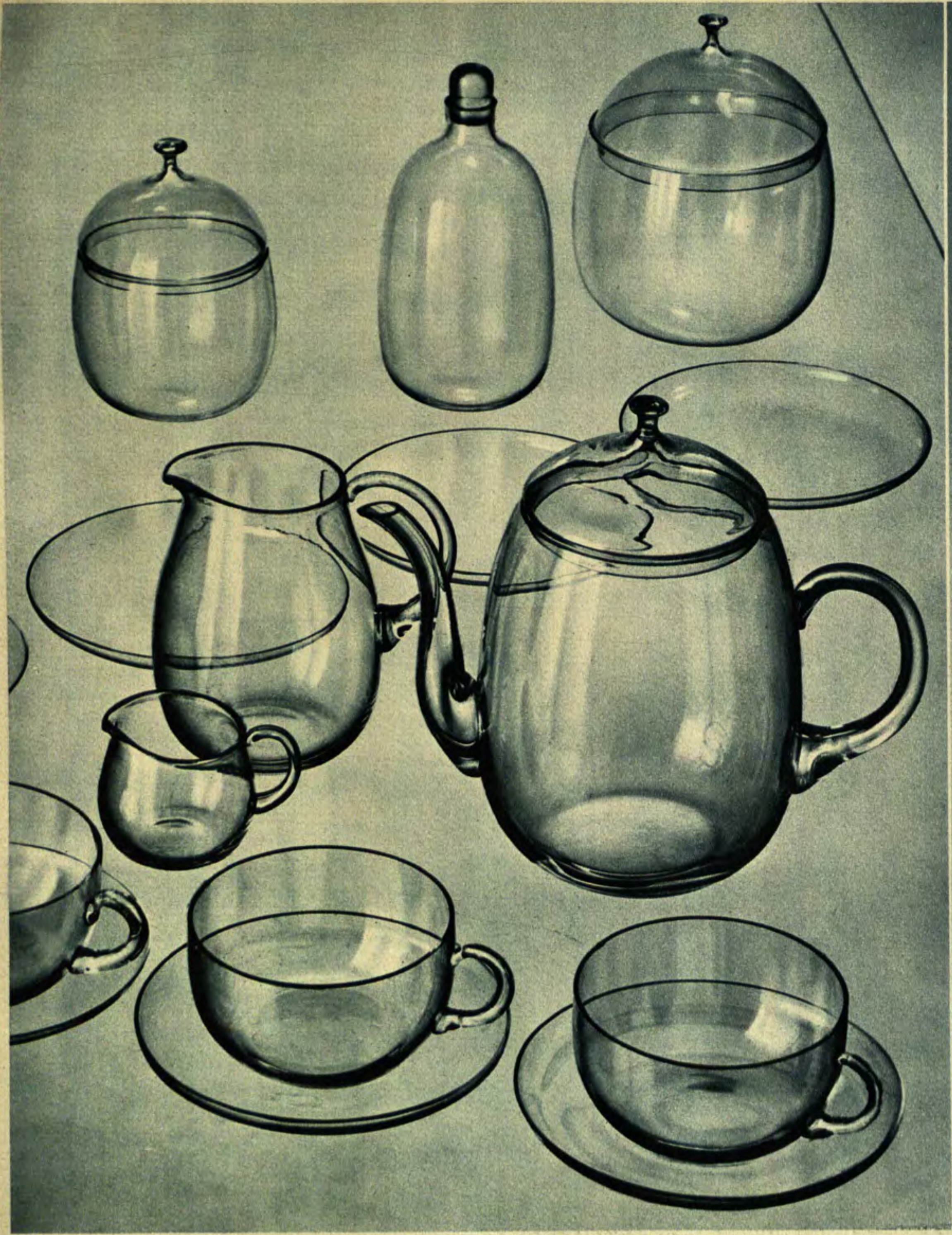
375. Věra Lišková: Wine Service, Crystal-Glass. "Artistic Glass" N. E. Lobmeyr Works, Kam. Šenov. Photo: J. Brok, Prague.



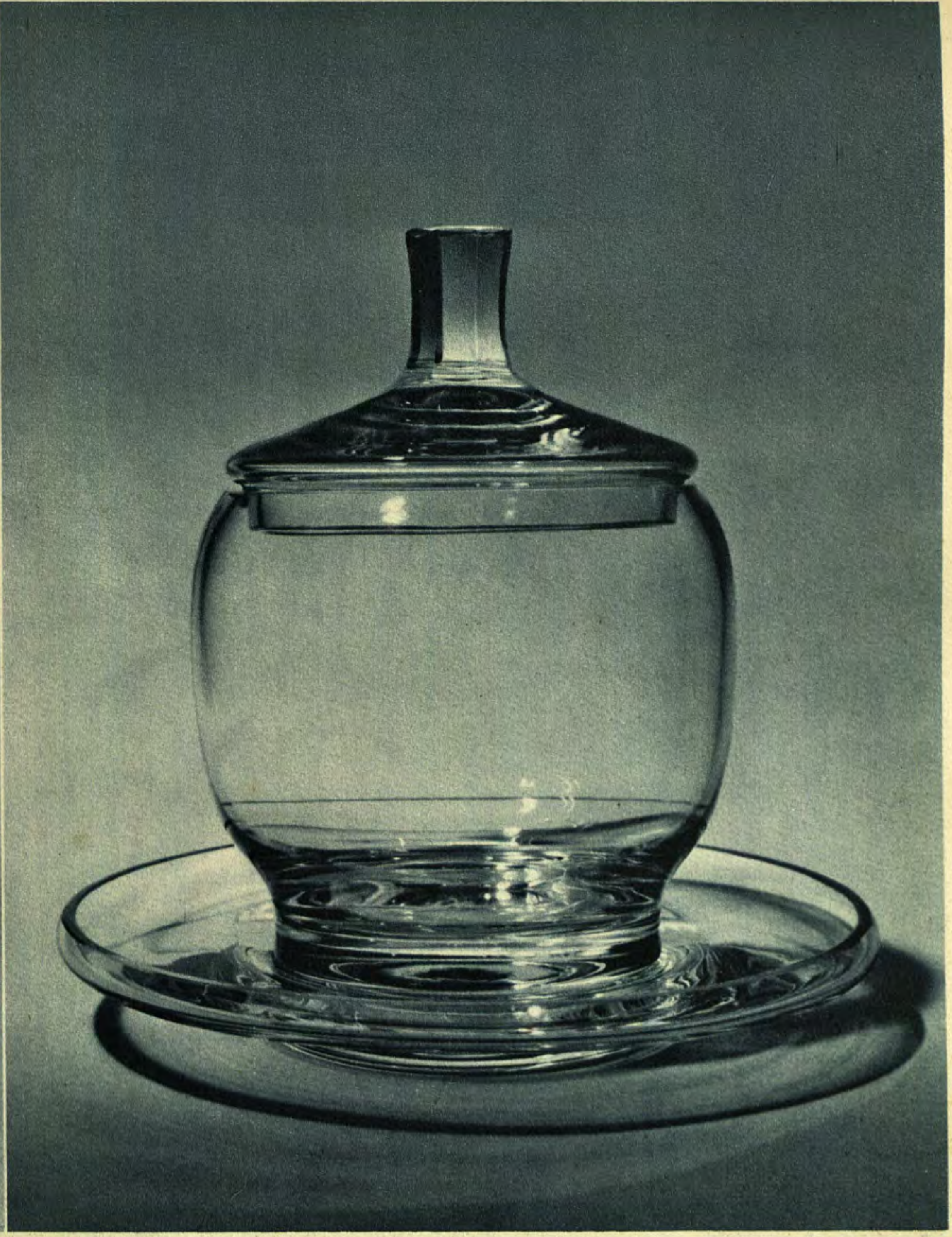
376. Erika Hellerová: Table Service. "Artistic Glass". N. E. Lobmeyr Works, Kam. Šenov. 1952.
Photo: V. Maruška.



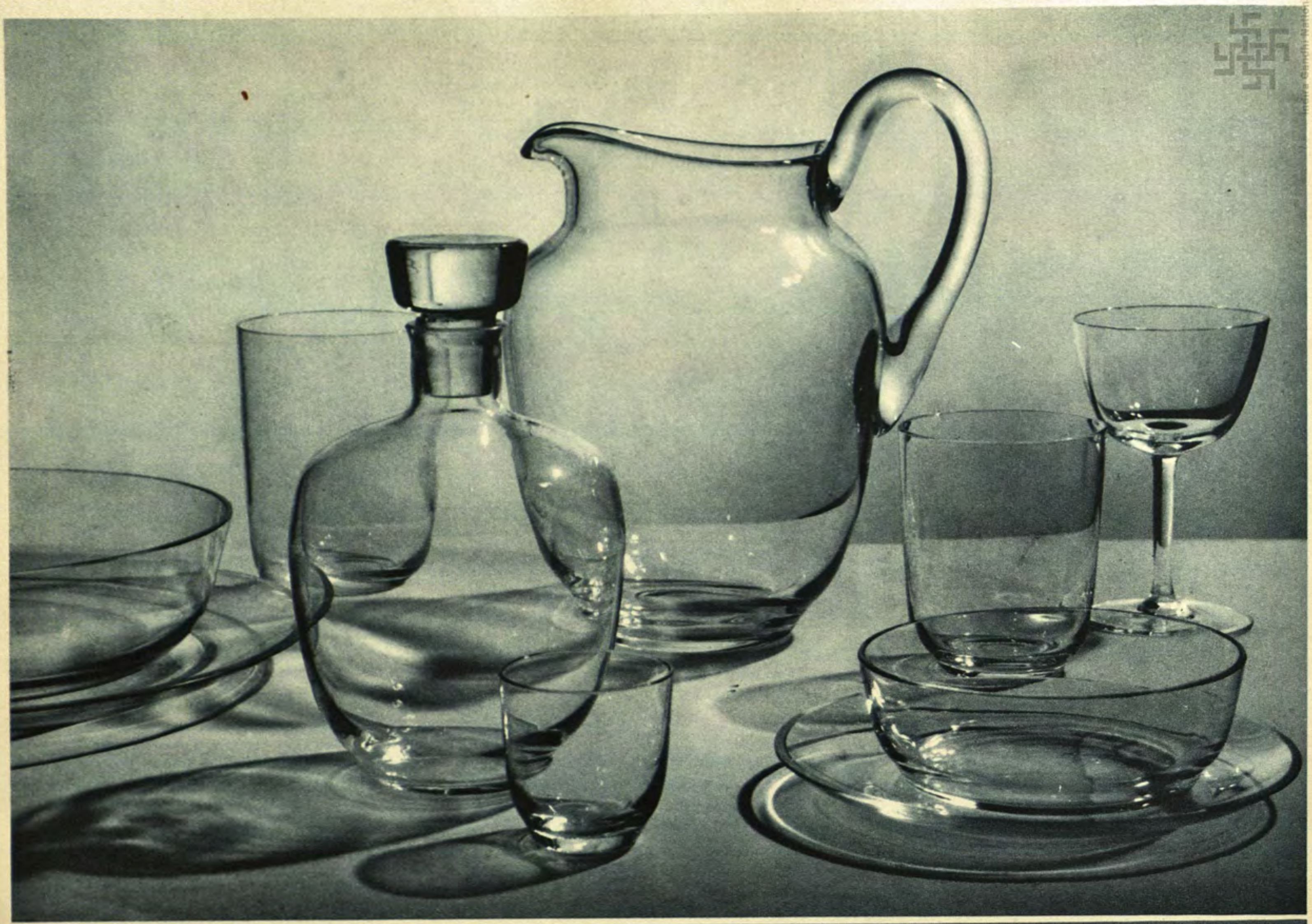
377. Milena Korousová: Table Service. Executed by the "Květen Glass Works" N. E. 1951.
Photo: J. Brok, Prague.

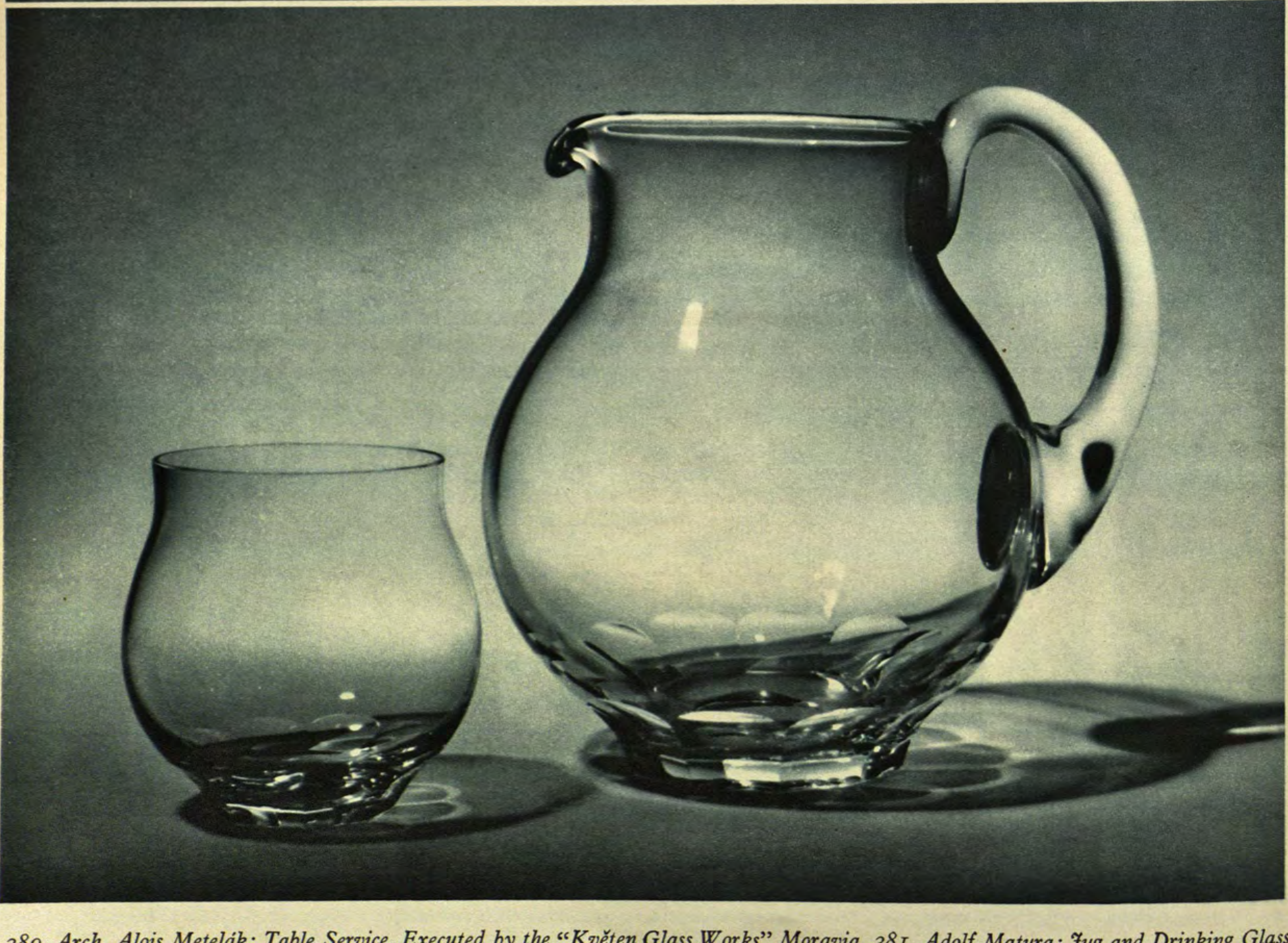


378. Prof. Stanislav Libenský: Tea Service. "Artistic Glass" N. E., Nový Bor. Photo: Kramer, Prague.

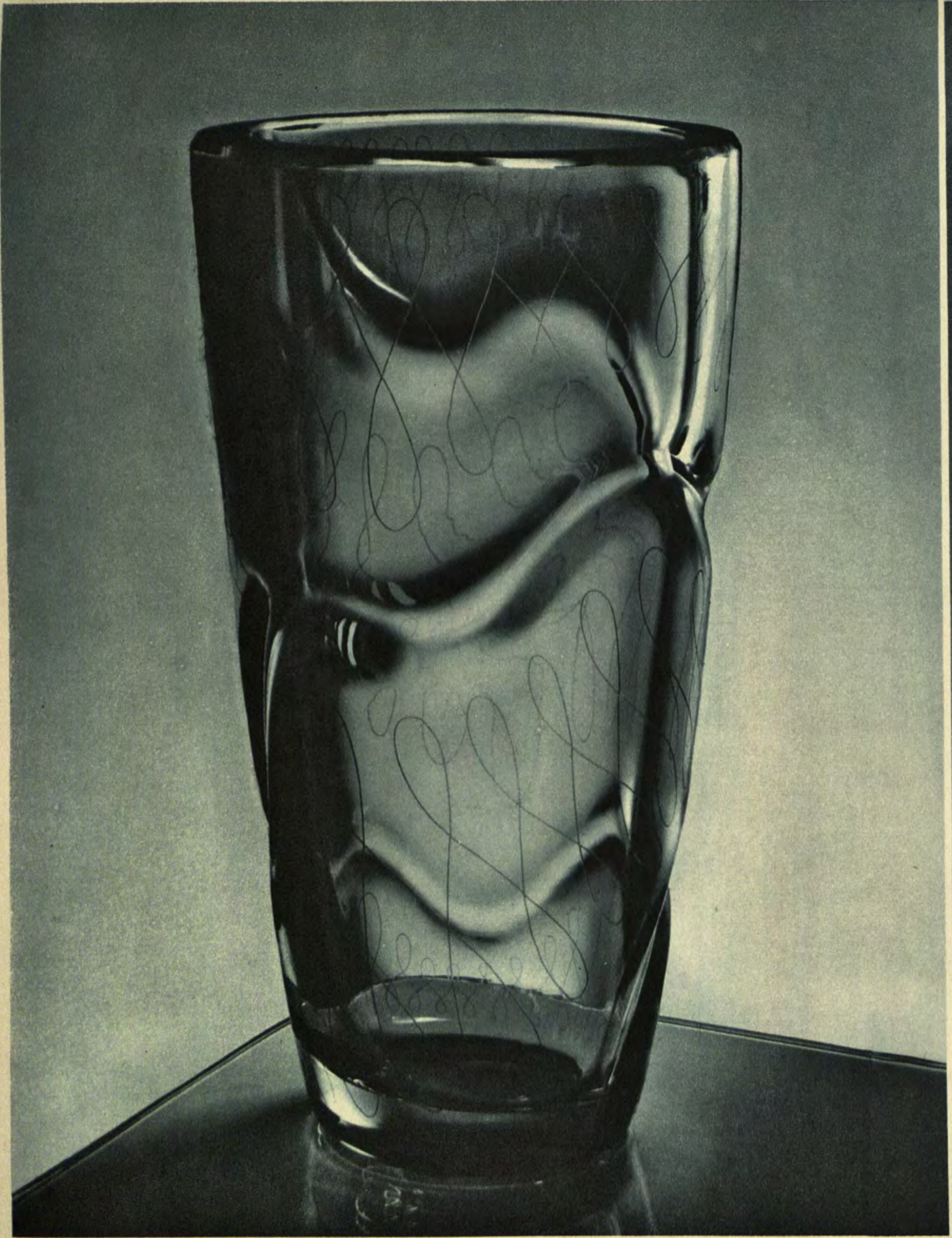


379. Pavel Hlava: Jar with Saucer with Cut Handle. Executed by the "Květen Glass Works", Moravia, 1953. (Co-operation V. S.) Photo: V. Rozegnal, Prague.

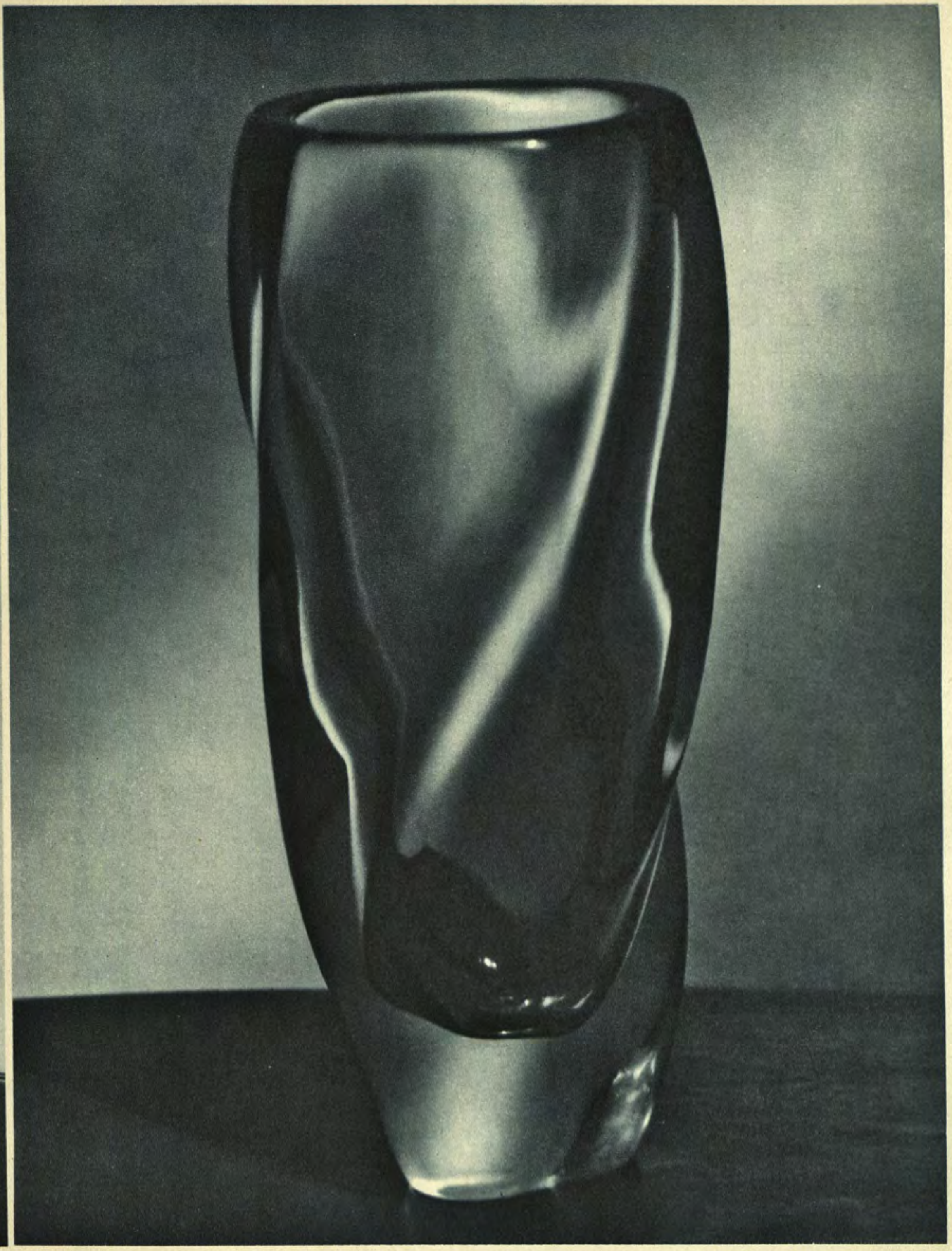




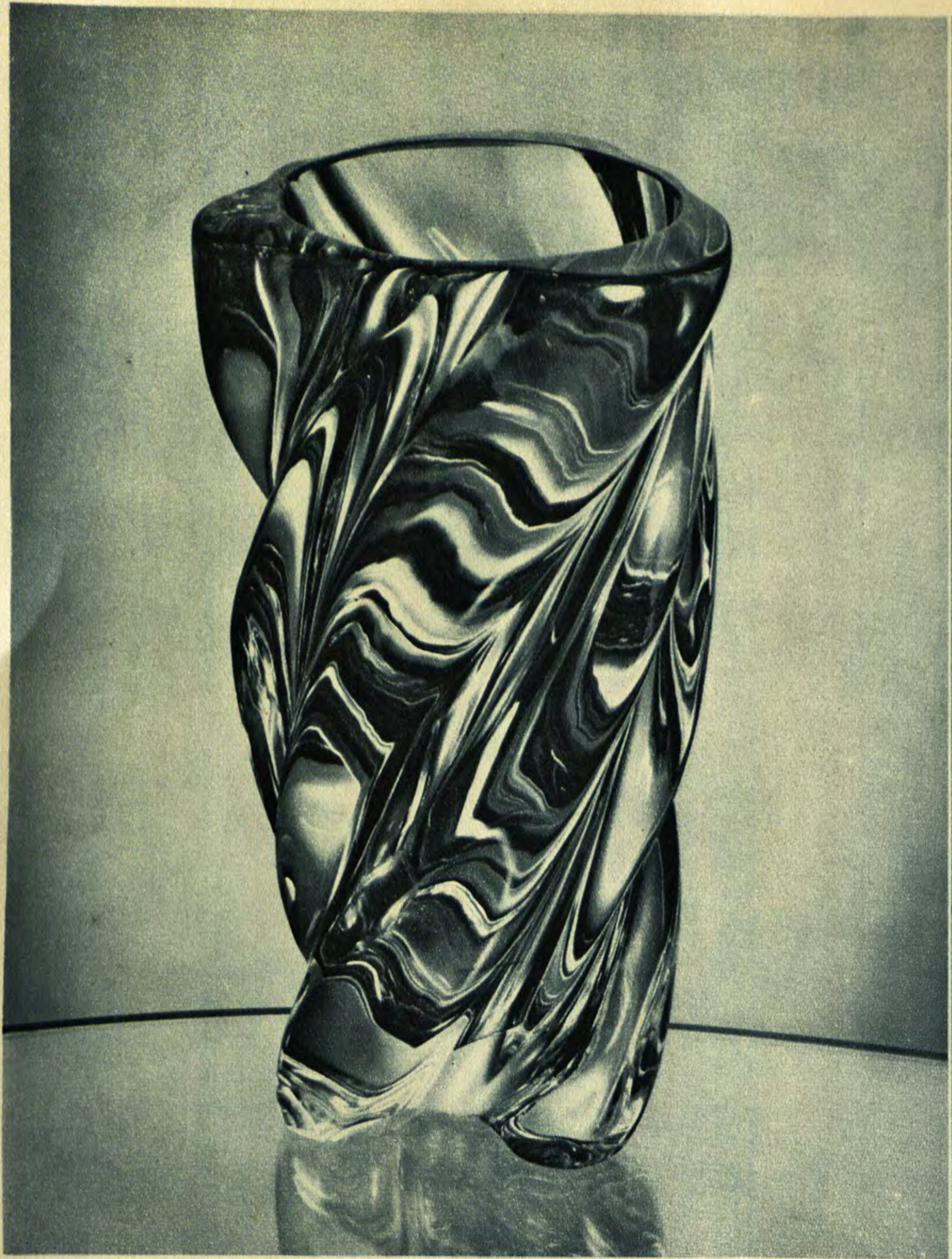
380. Arch. Alois Metelák: Table Service. Executed by the "Květen Glass Works" Moravia. 381. Adolf Matura: Jug and Drinking Glass with Polished Cut. Executed by the Karlovy Vary Glass Works N. E., Dvory Works, 1953. (Co-operation V. S.) Photo: V. Rozegnal, Prague.



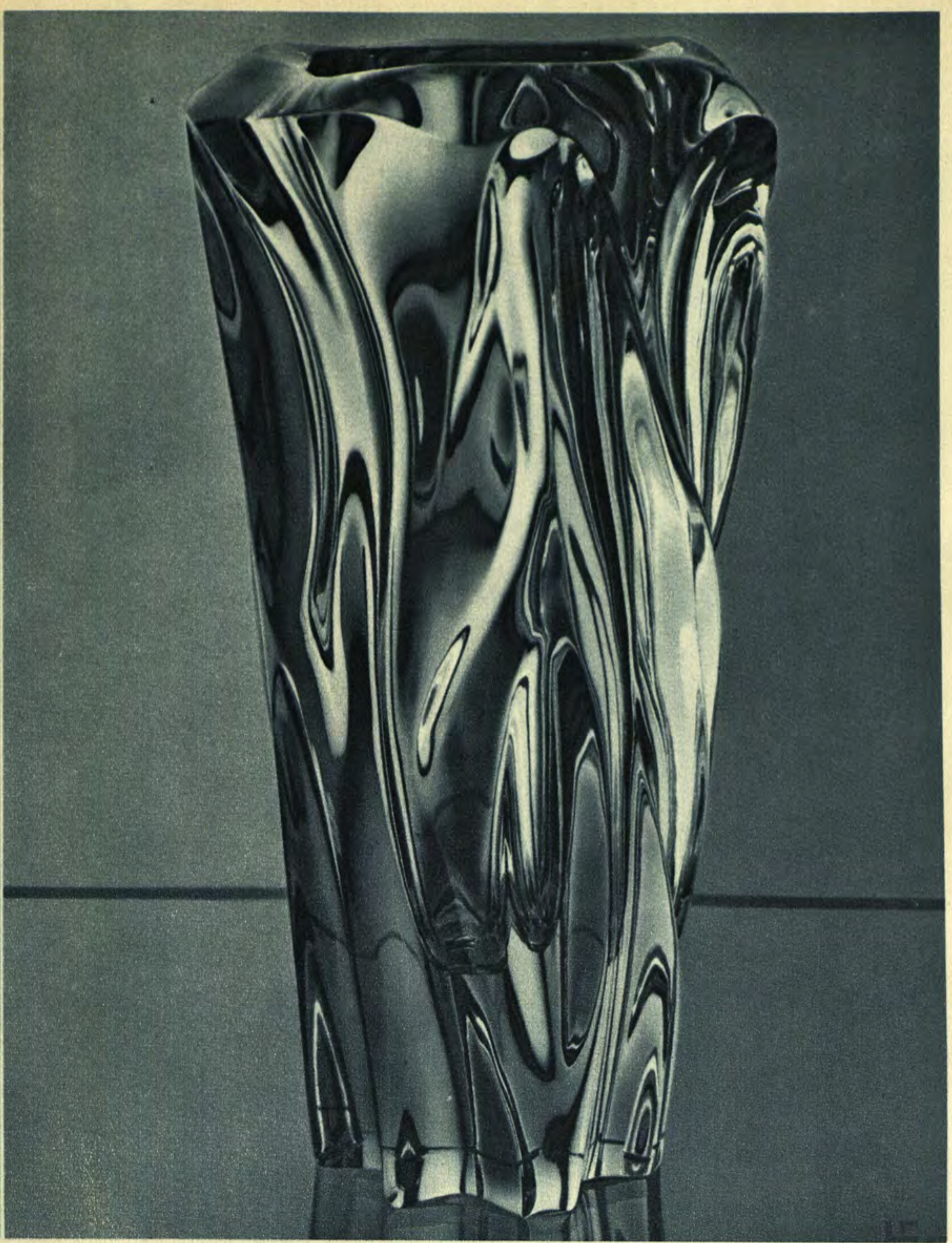
382. Jiřina Pastrnková: Cut-Glass Vase. Železný Brod. Photo: Honty, Prague.



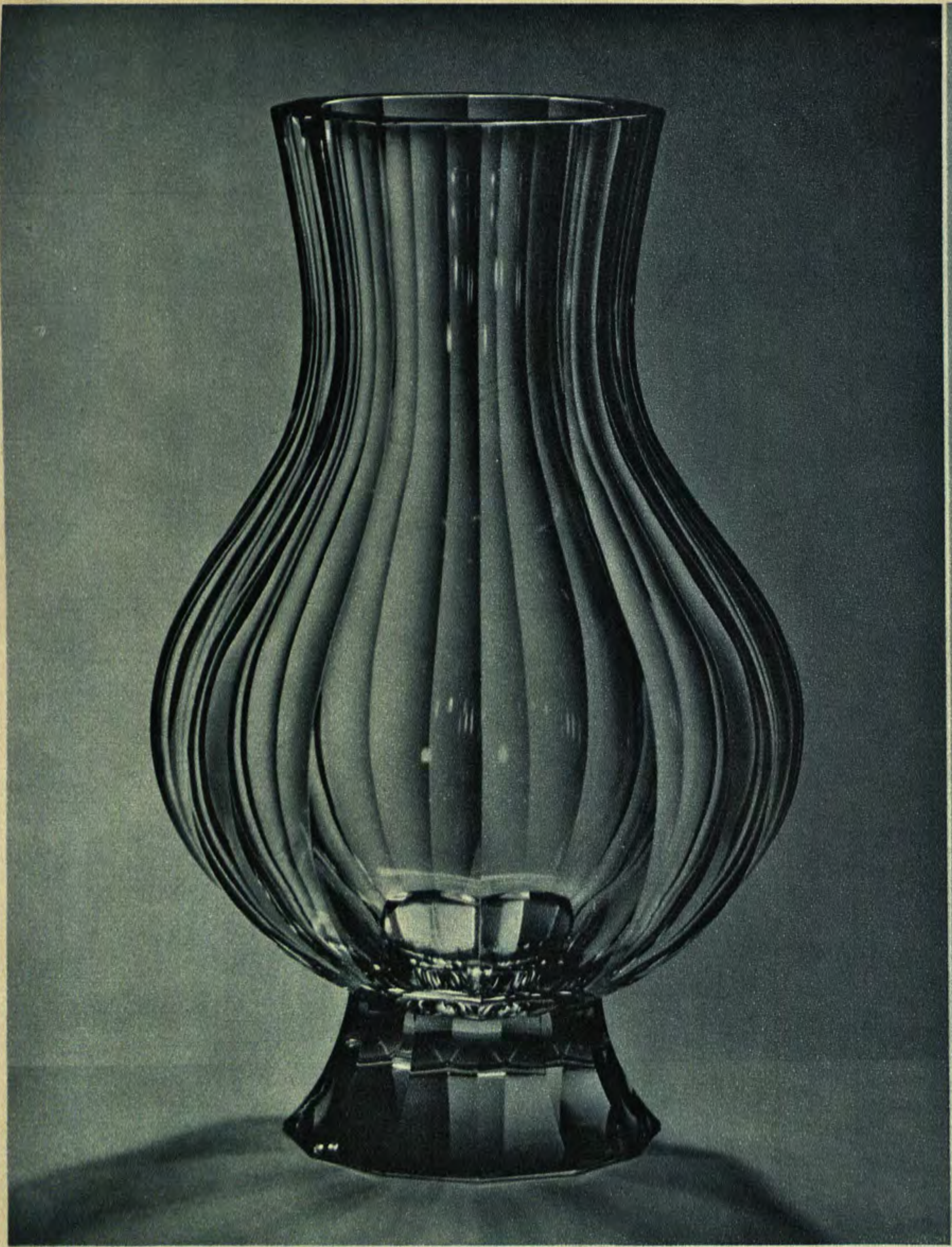
383. Prof. René Roubíček: Cut-Glass Vase. Crystal-Glass. State Technical School in Kam. Šenov. 1947. ÚLUV. Photo: J. Otto, Prague.



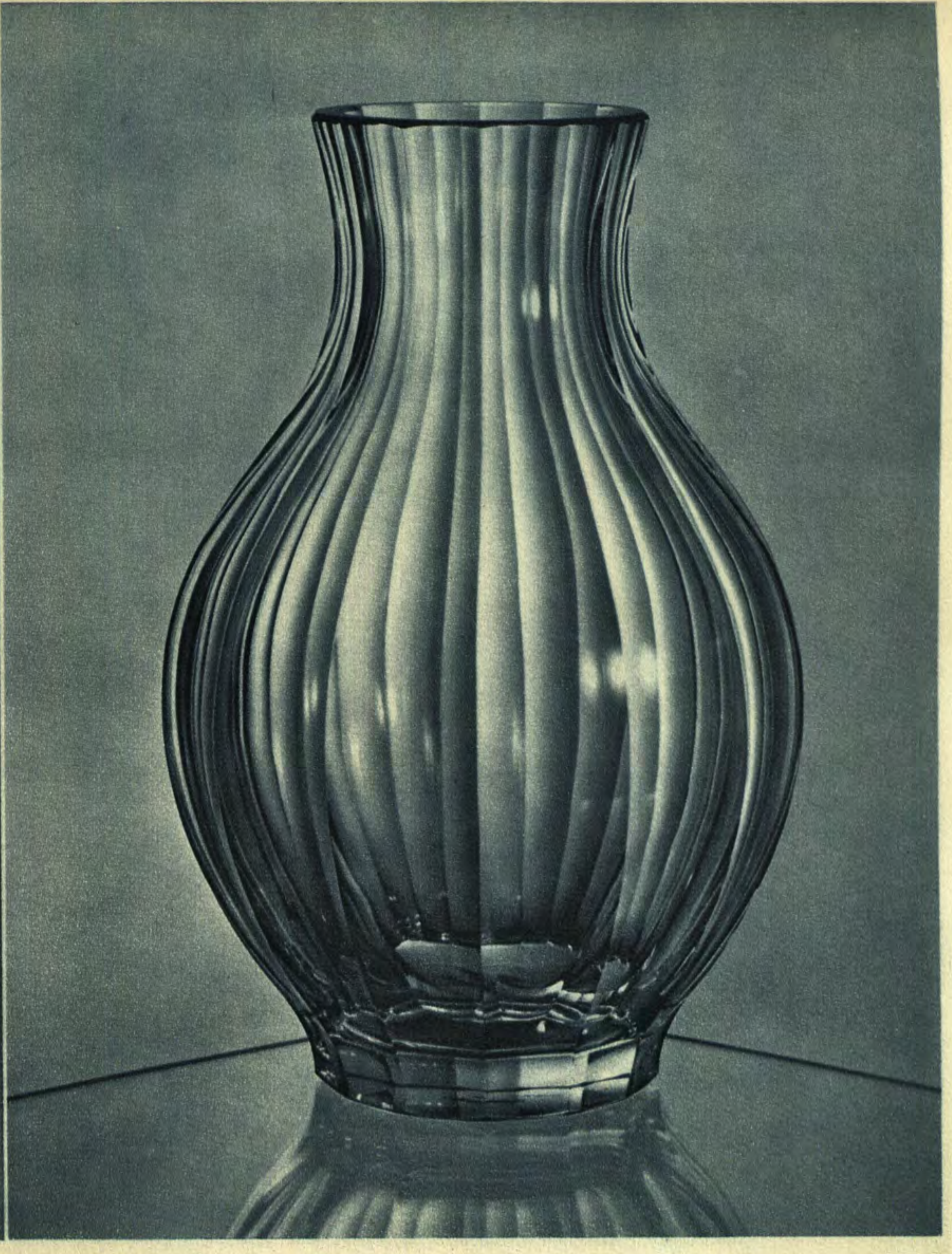
384. Robert Boháček: Relief Cut Vase. 1949. Photo: Rott.



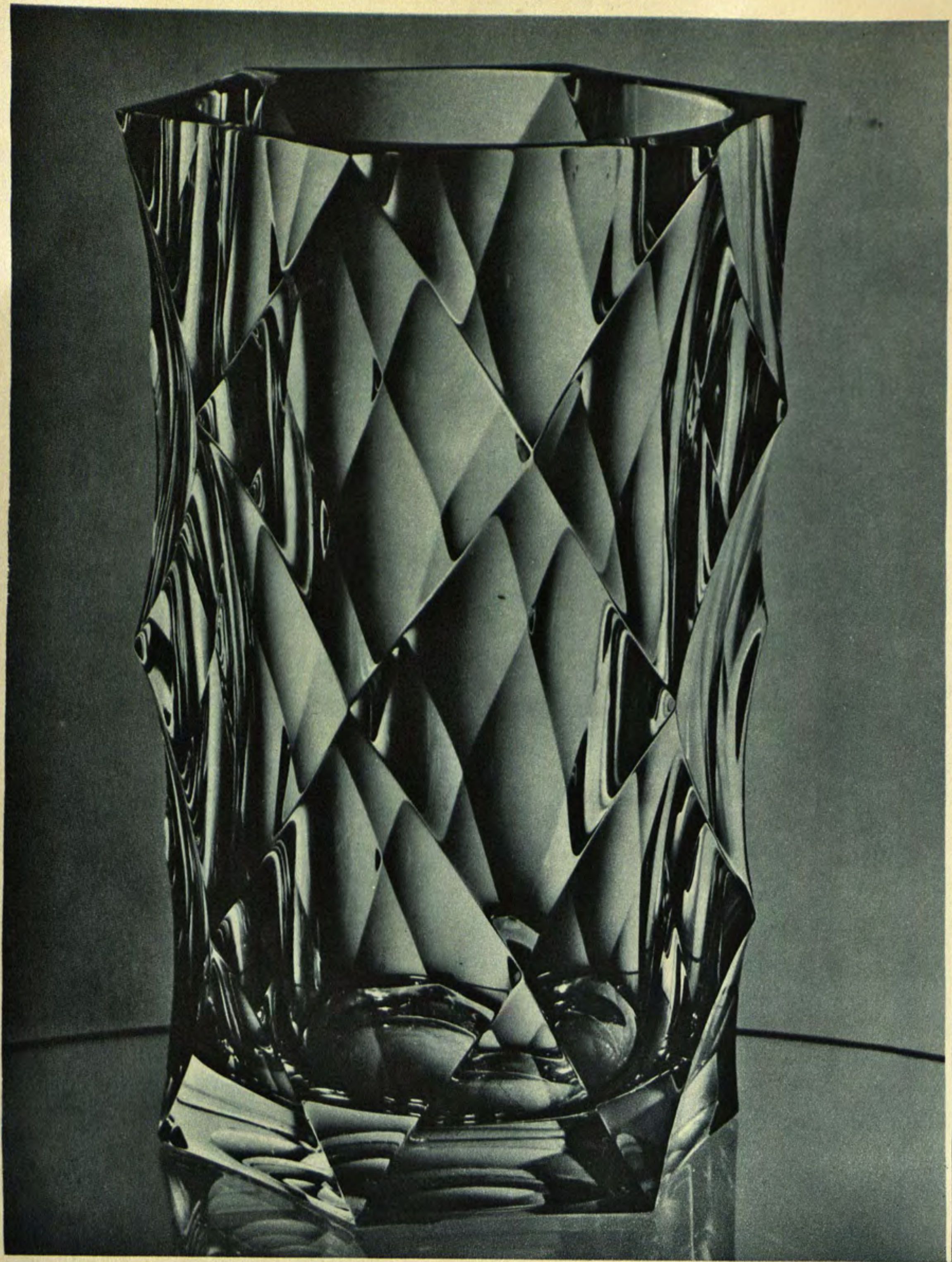
385. Prof. Stanislav Libenský: Cut Vase. 1953. Photo: J. Brok, Prague.



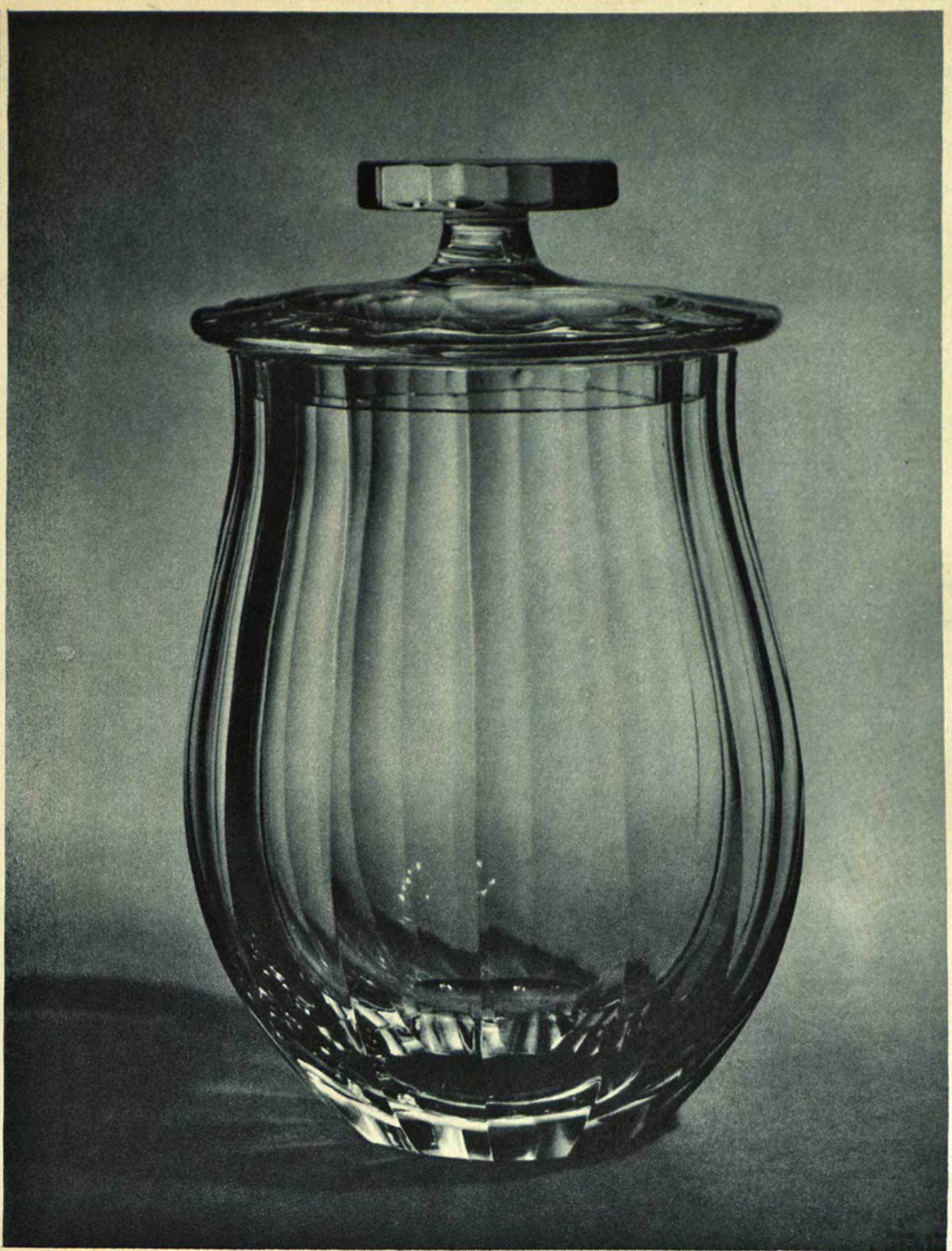
386. Václav Plátek: Cut-Glass Vase. "Artistic Glass" N. E. Lobmeyr Works, Kam. Šenov. Photo: J. Brok, Prague.



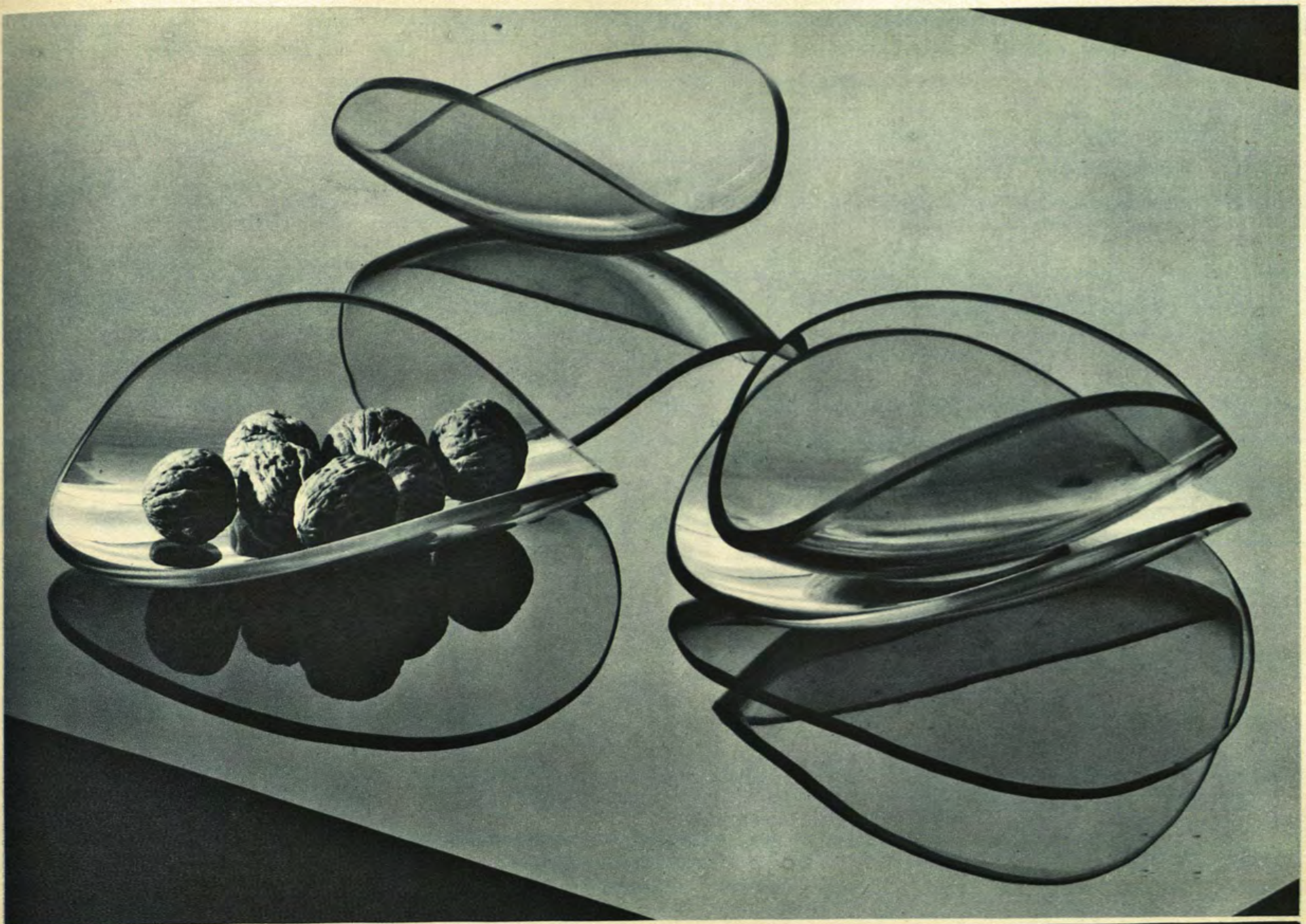
387. Věra Lišková: Vase of Coloured Glass, Decorated with an Edge-Cut. Karlovy Vary Glass, N. E. Moser Works. Photo: J. Brok, Prague.

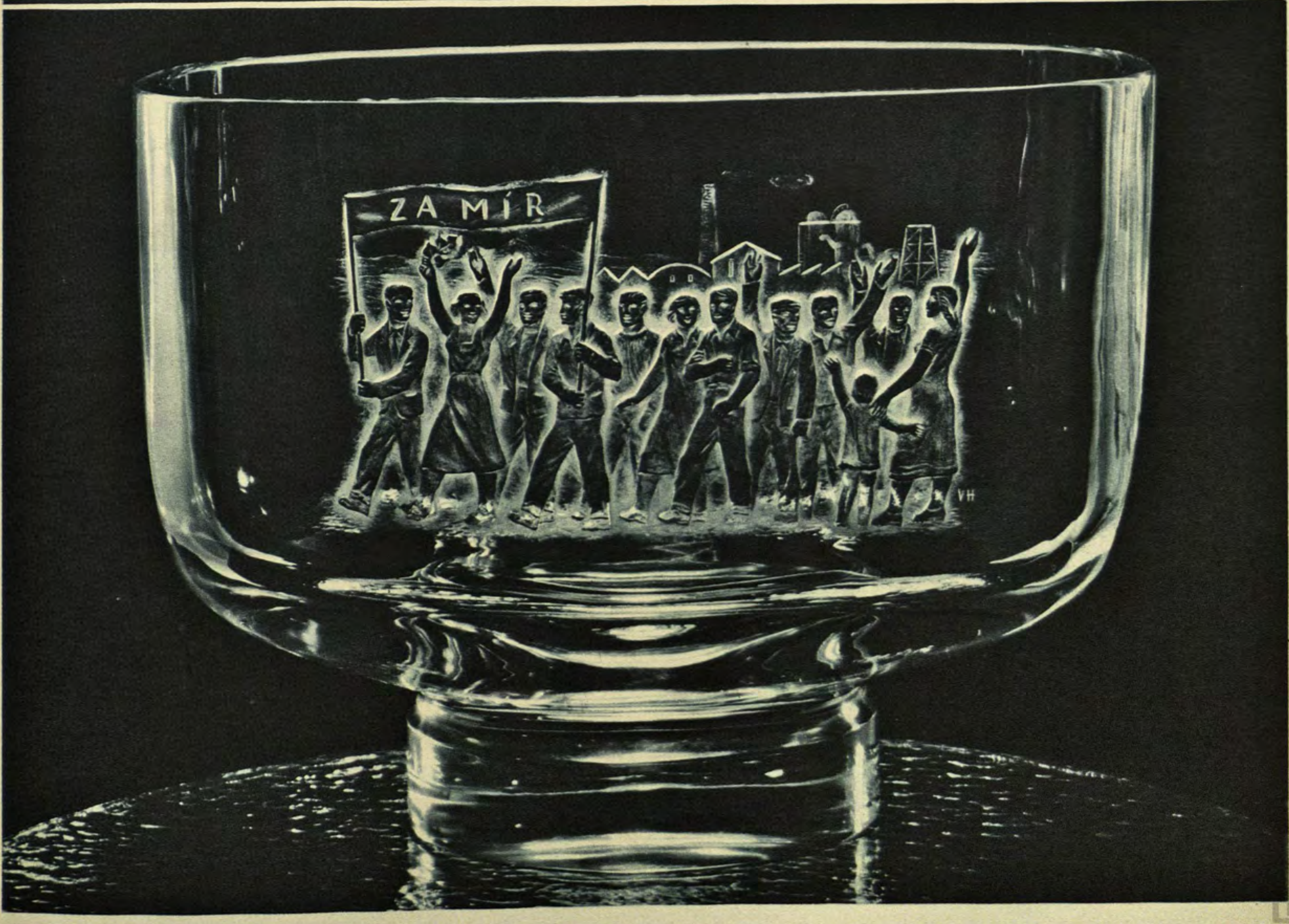


388. *Václav Plátek: Vase of Cut-Glass. Železný Brod Glass, N. E., 1951. Photo: J. Brok, Prague.*



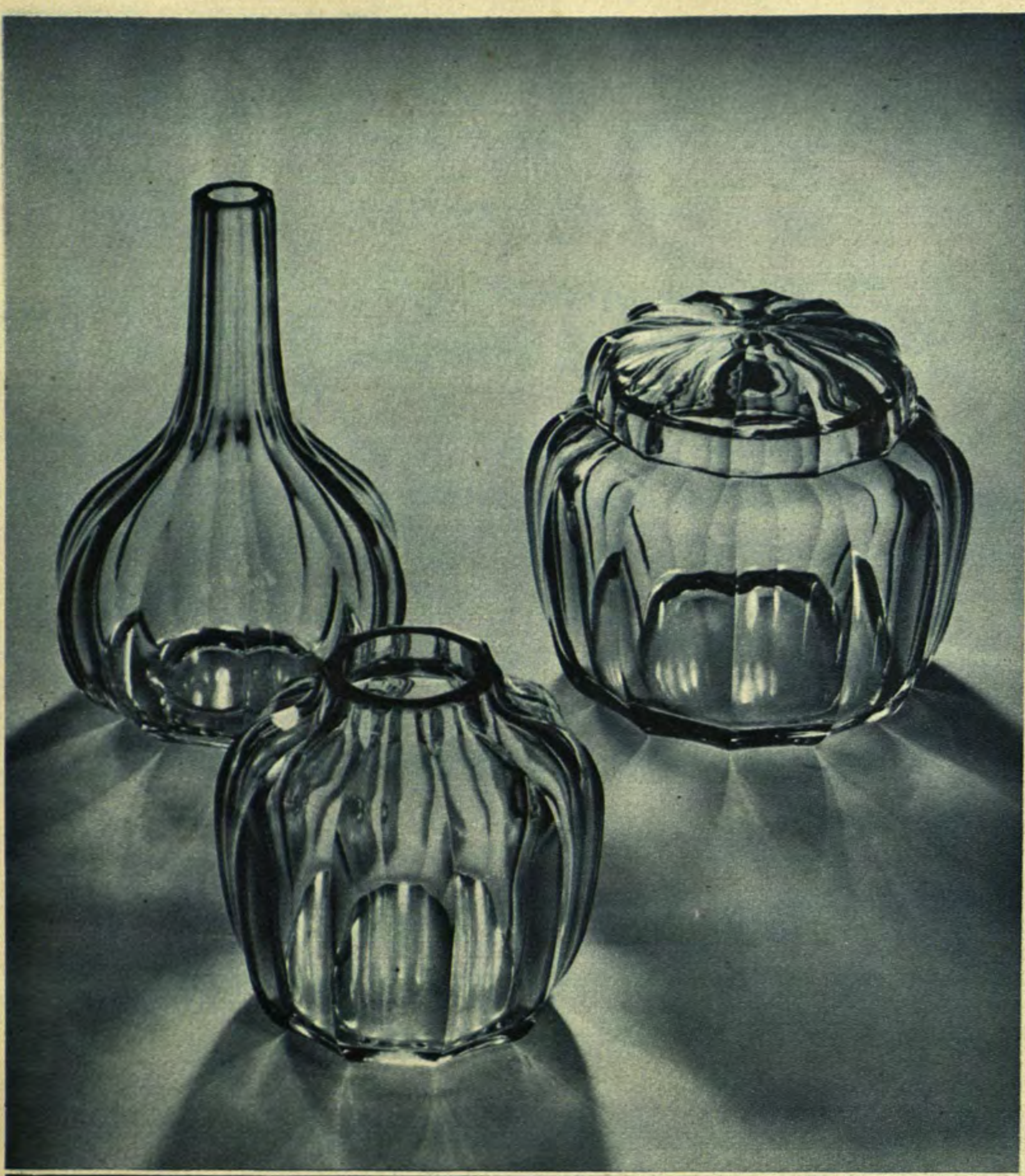
389. *Milena Kytková-Roubíčková: Honey Jar. Cut Crystal-Glass. "Artistic Glass", N. E. Nový Bor. Photo: V. Rozegnal.*



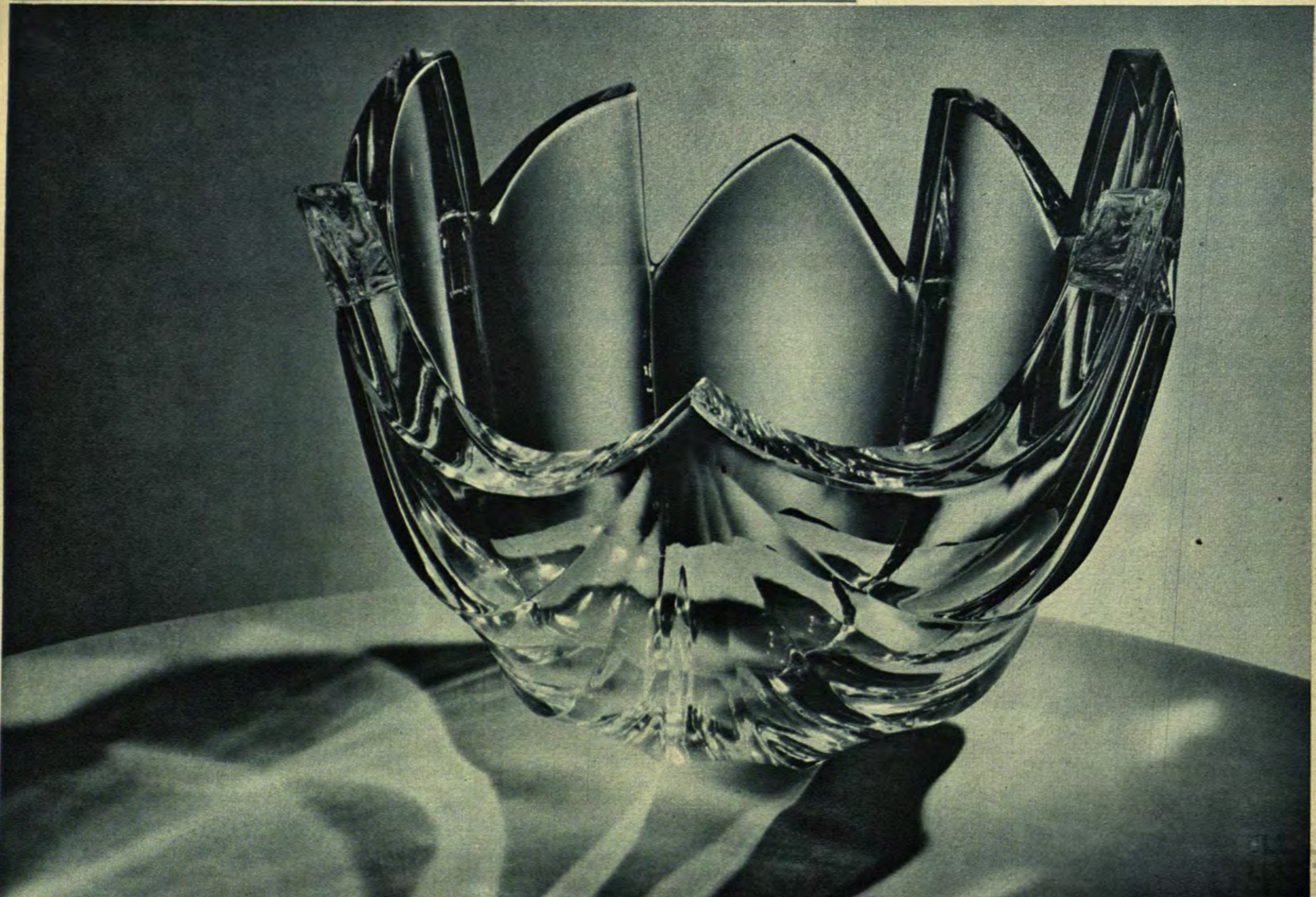


390. *Robert Boháček: Cut-Glass Dishes of Crystal-Glass. Photo: J. Brok, Prague.* 391. *Václav Hanuš: Cut and Relief-Cut Jardinière. "Artistic Glass" N. E. Nový Bor. Photo: J. Brok, Prague.*

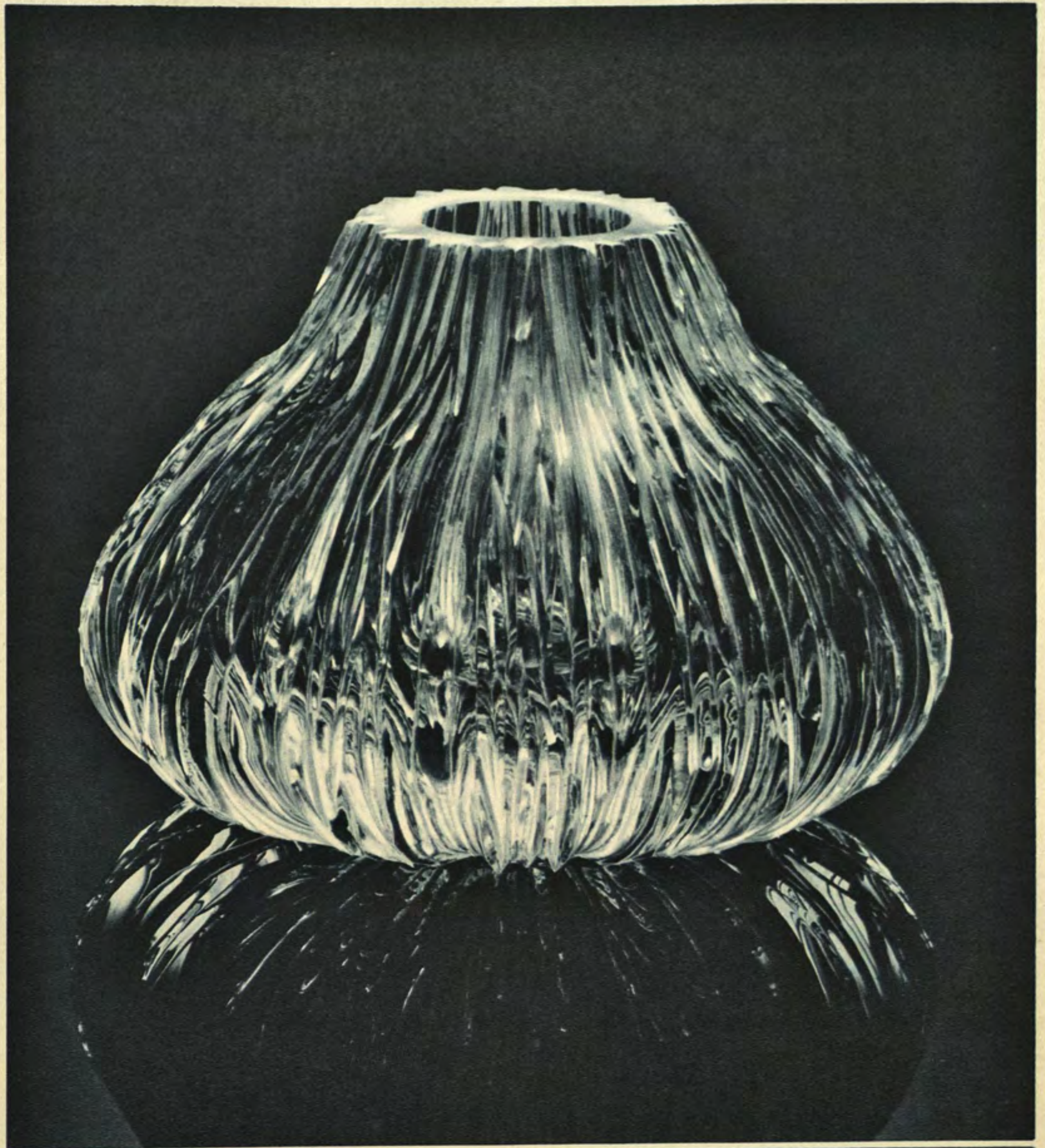
392. *Věra Lišková: Cut-Glass Service. "Artistic Glass", N. E. Lobmeyr Works, Kam. Šenov. Photo: J. Brok, Prague.*



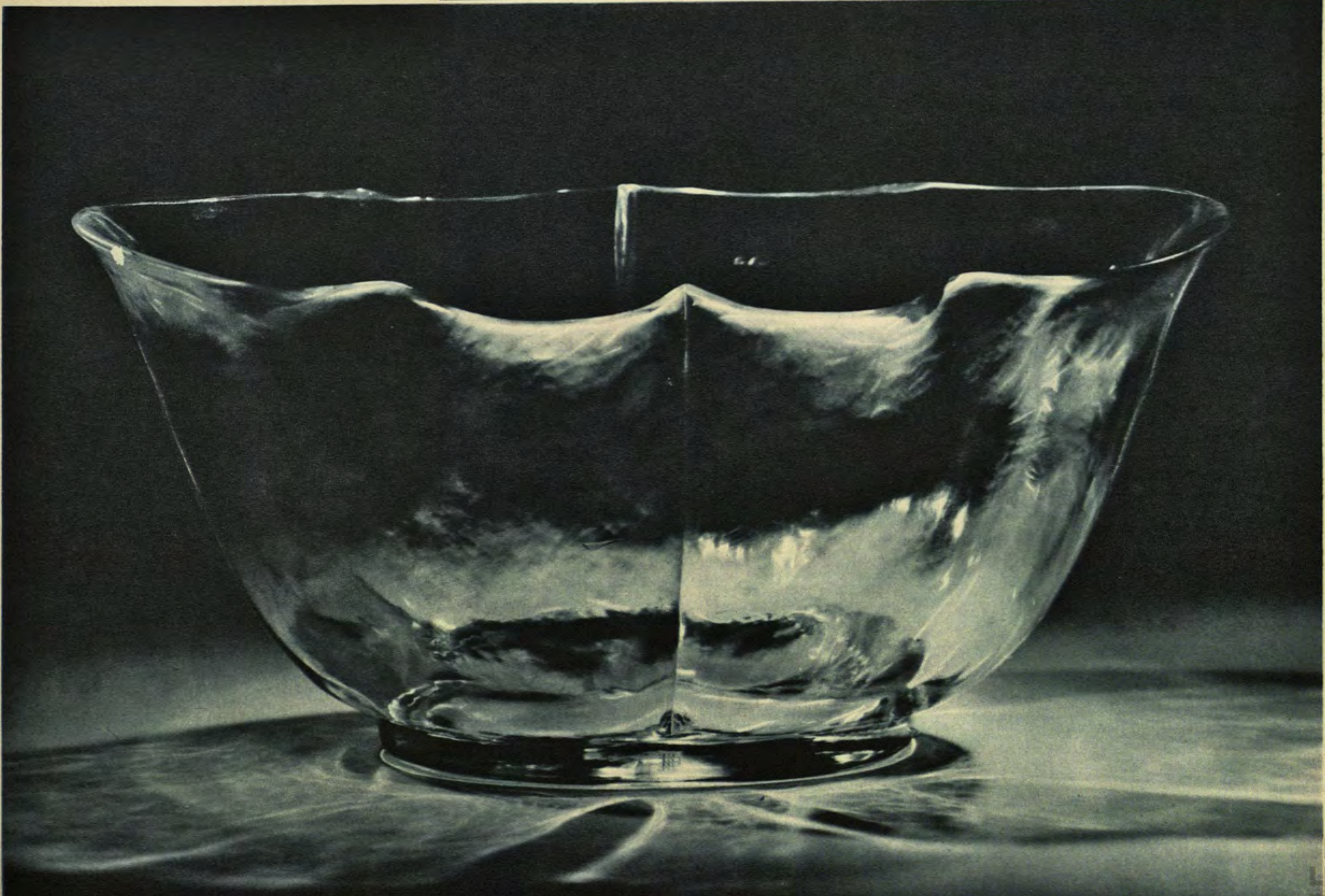
393. *Ludvika Smrčková: Cut Lead-Glass Dish. Photo: J. Brok, Prague.*

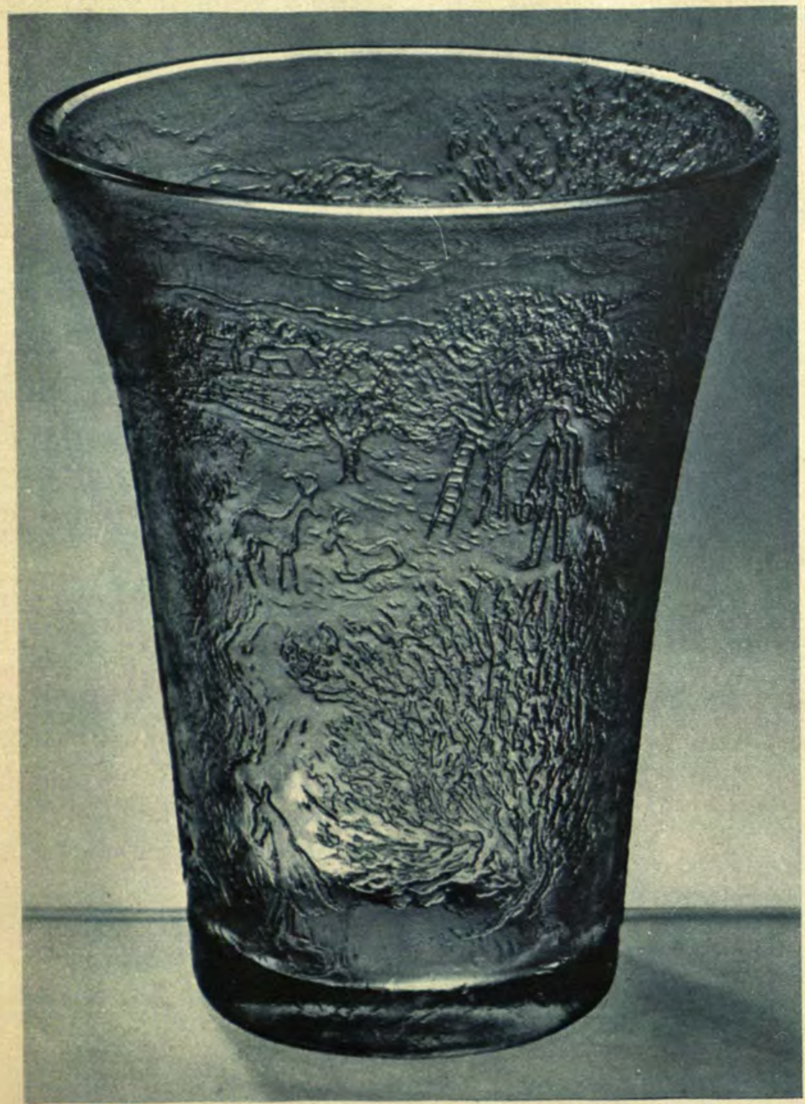


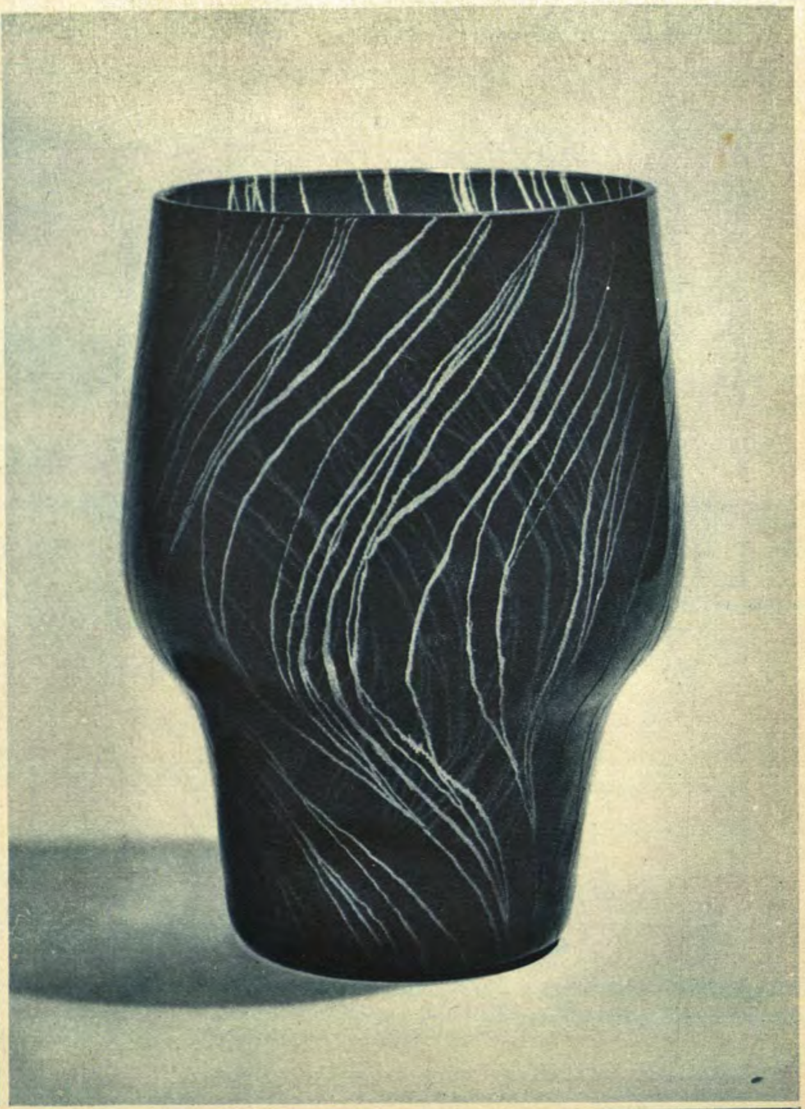
394. Miluše Kytková-Roubíčková: Cut, Decorative Vase of Lead-Glass, 1950. "Artistic Glass". N. E. Photo: J. Brok, Prague.

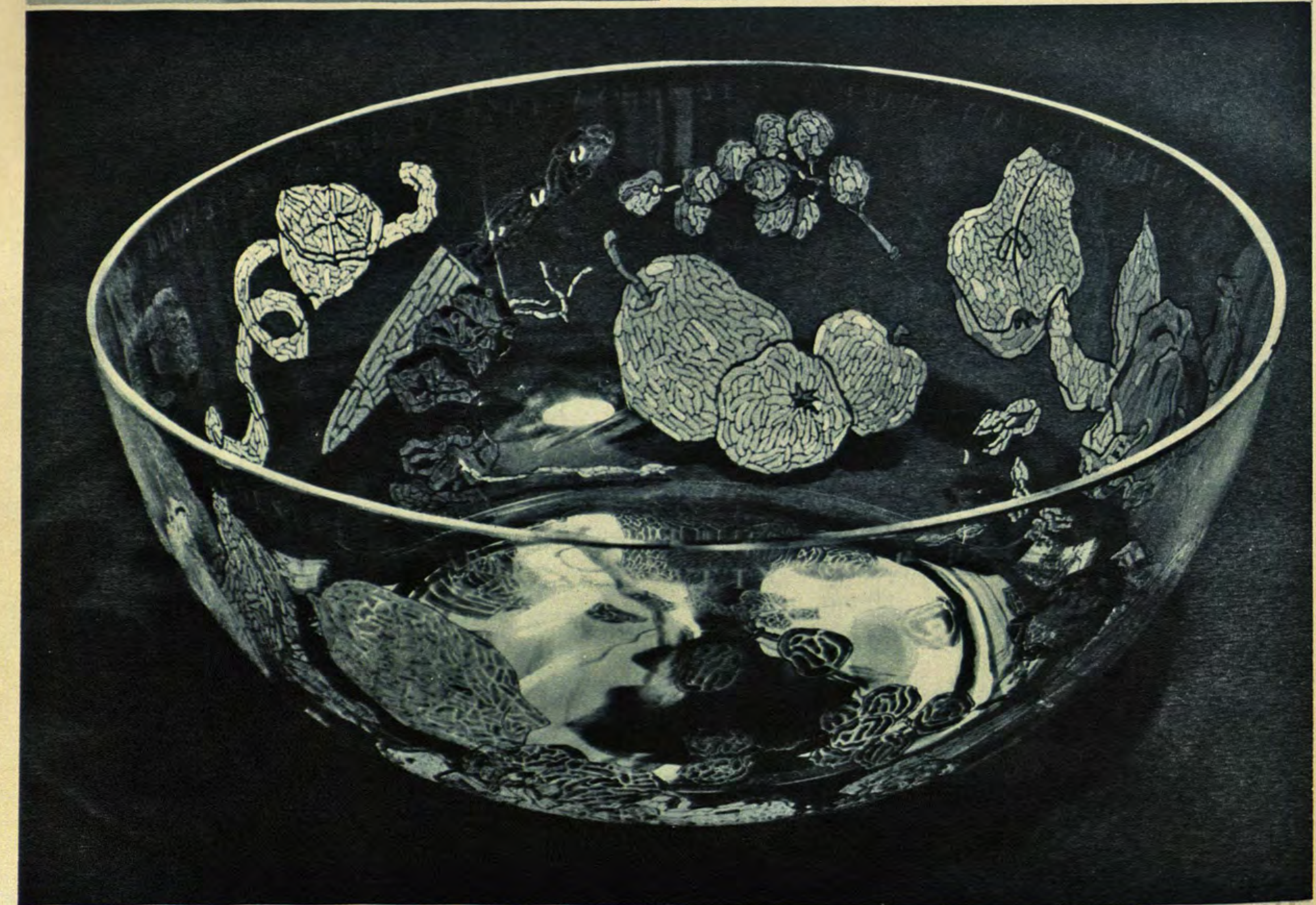


395. M. Rathová-Backhausenová: Cut Jardinière. "Artistic Glass", N. E. Lobmeyr Works. Kam. Šenov. Photo: J. Otto.

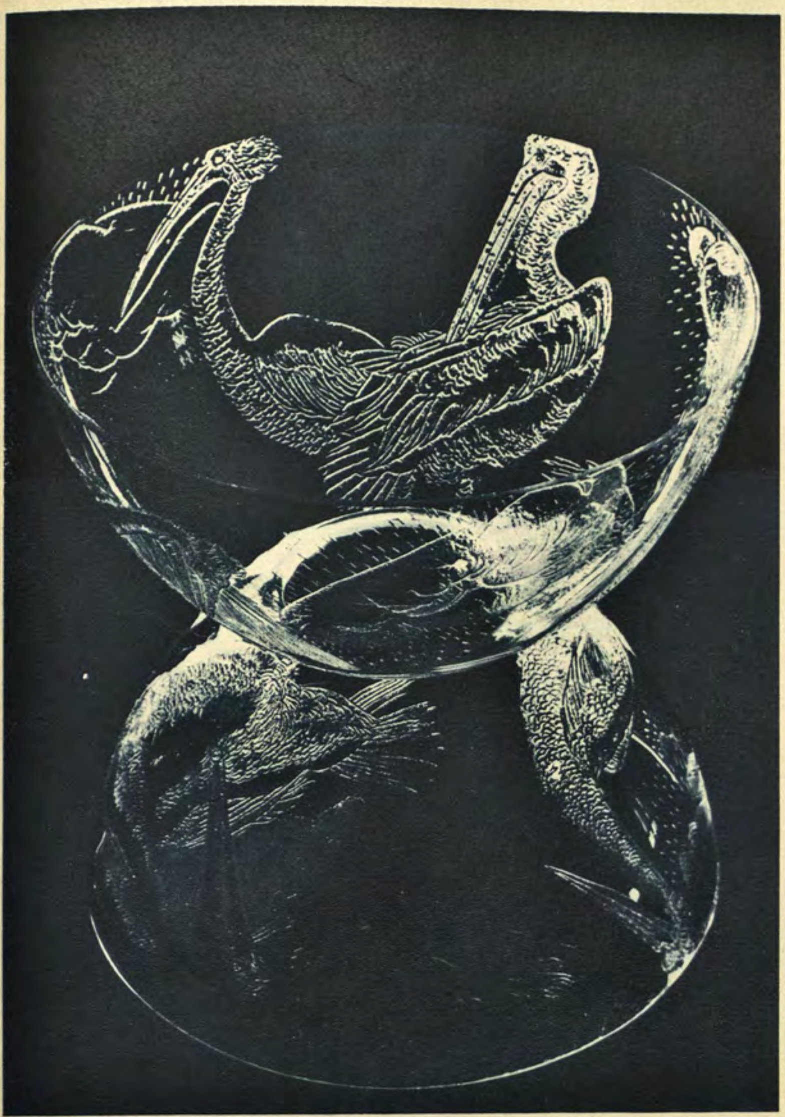


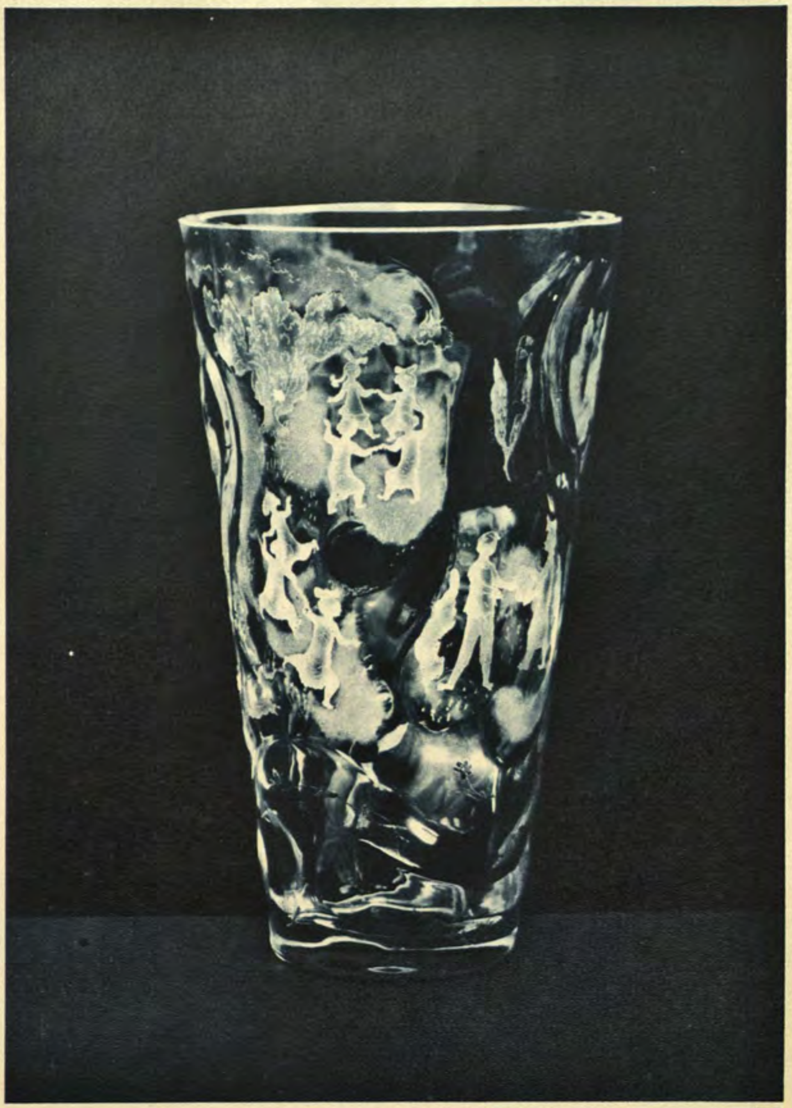


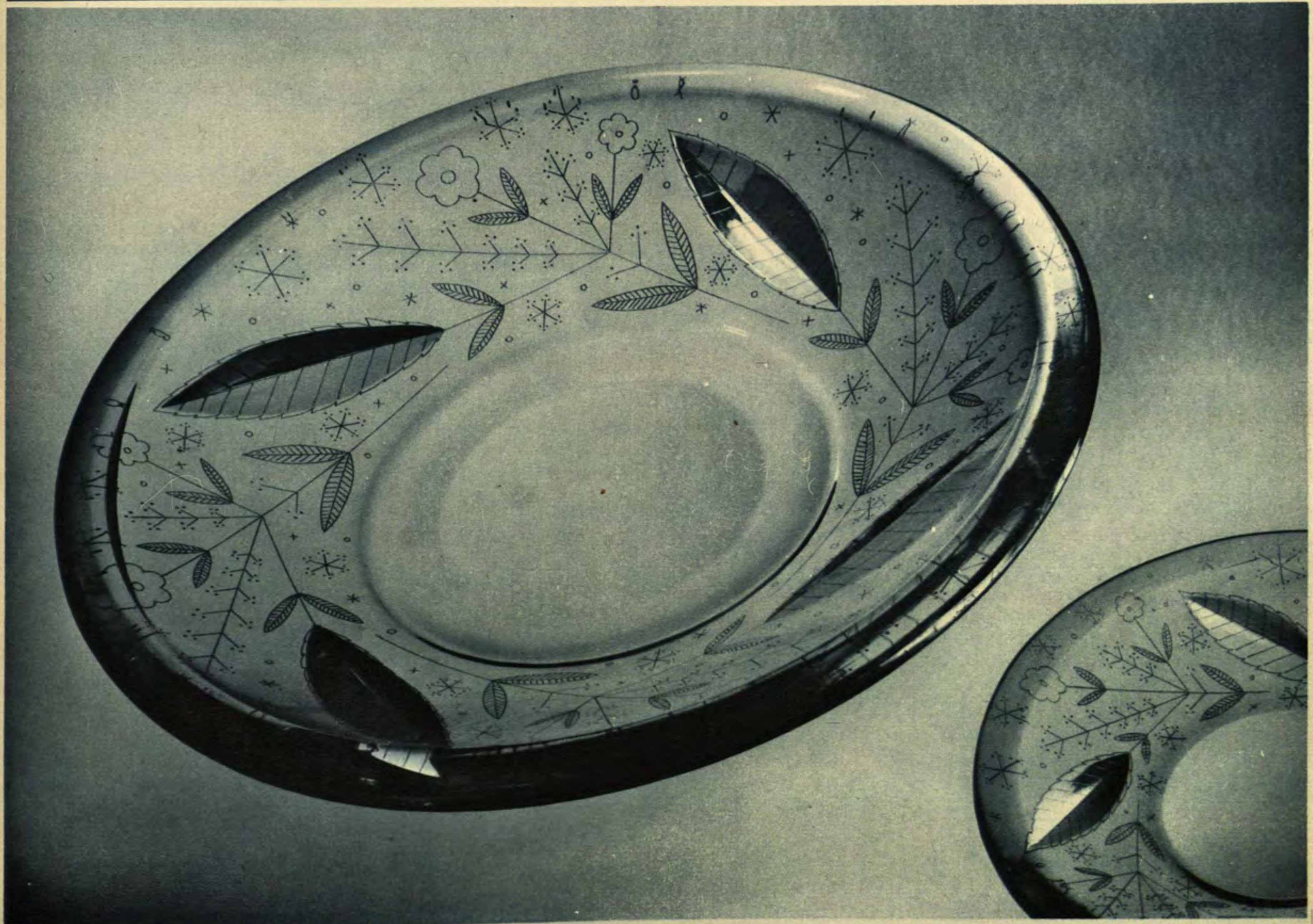




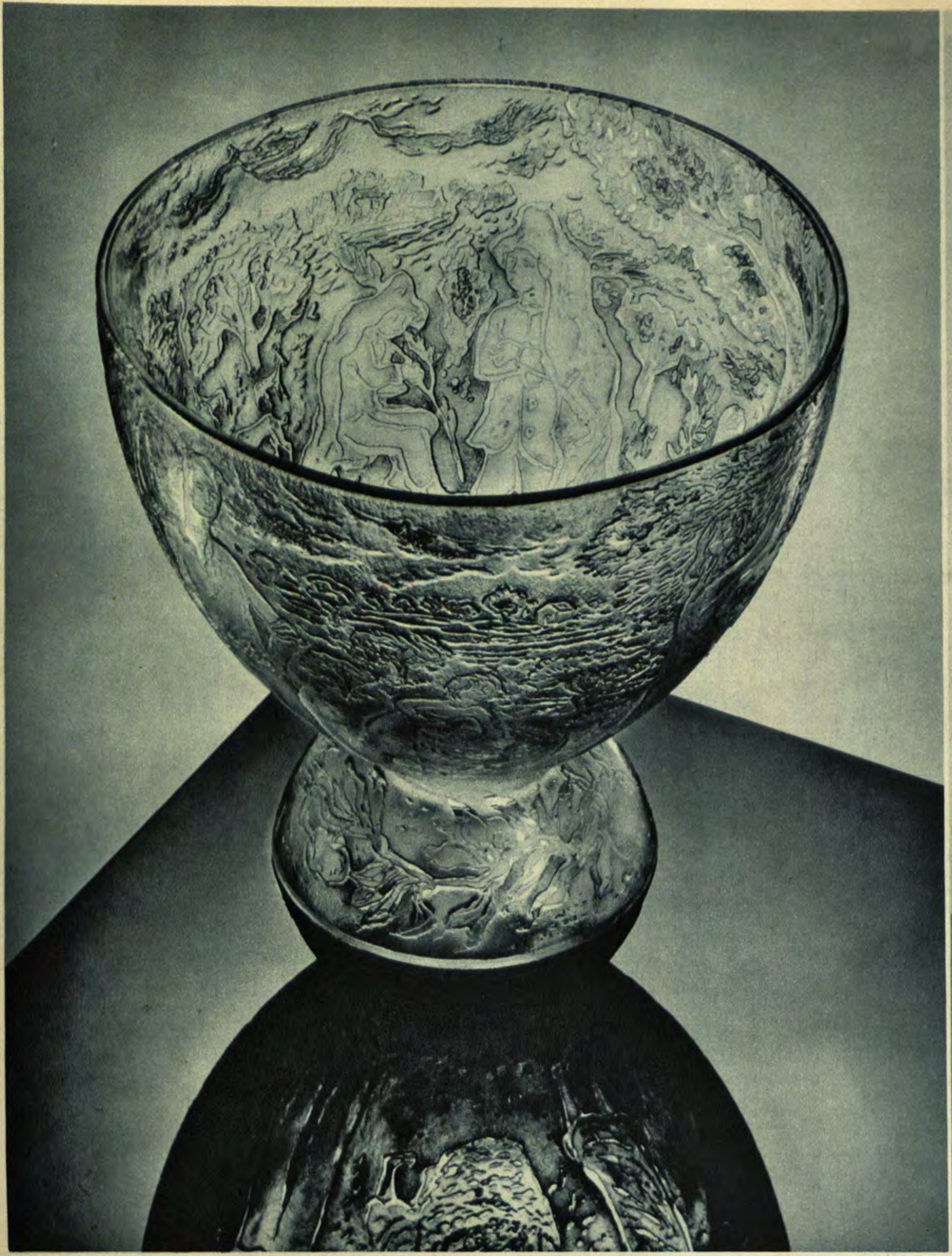
396. Miroslav Janků: Etched and Painted Vase. Photo: J. Brok, Prague. 397. Miluše Kytková: Red-Glazed Vase. 1953. "Artistic Glass", N. E. Nový Bor. Photo: V. Rozegnal. 398. Jiřina Pastrnková: Painted Dish. Železný Brod. Photo: J. Brok, Prague.



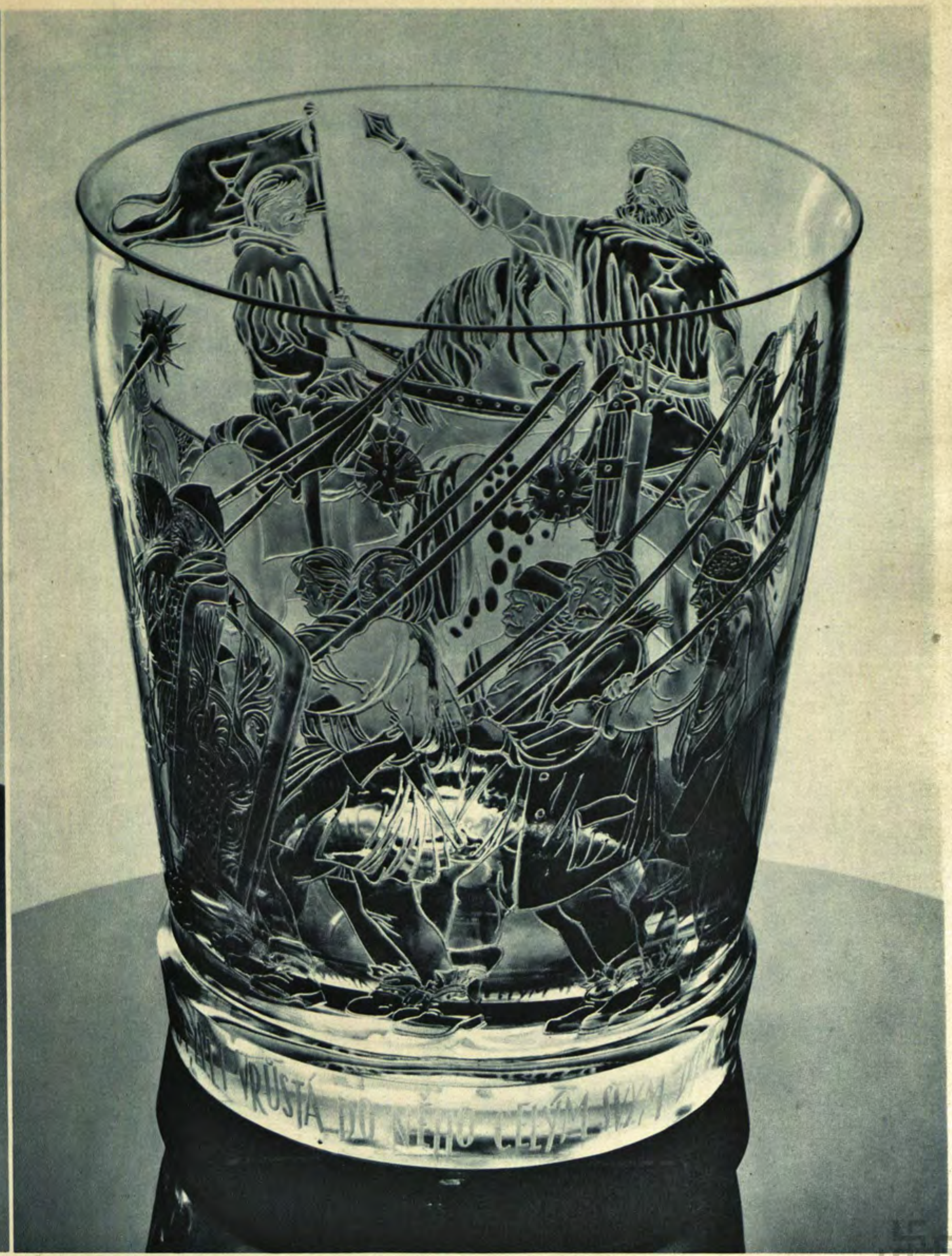




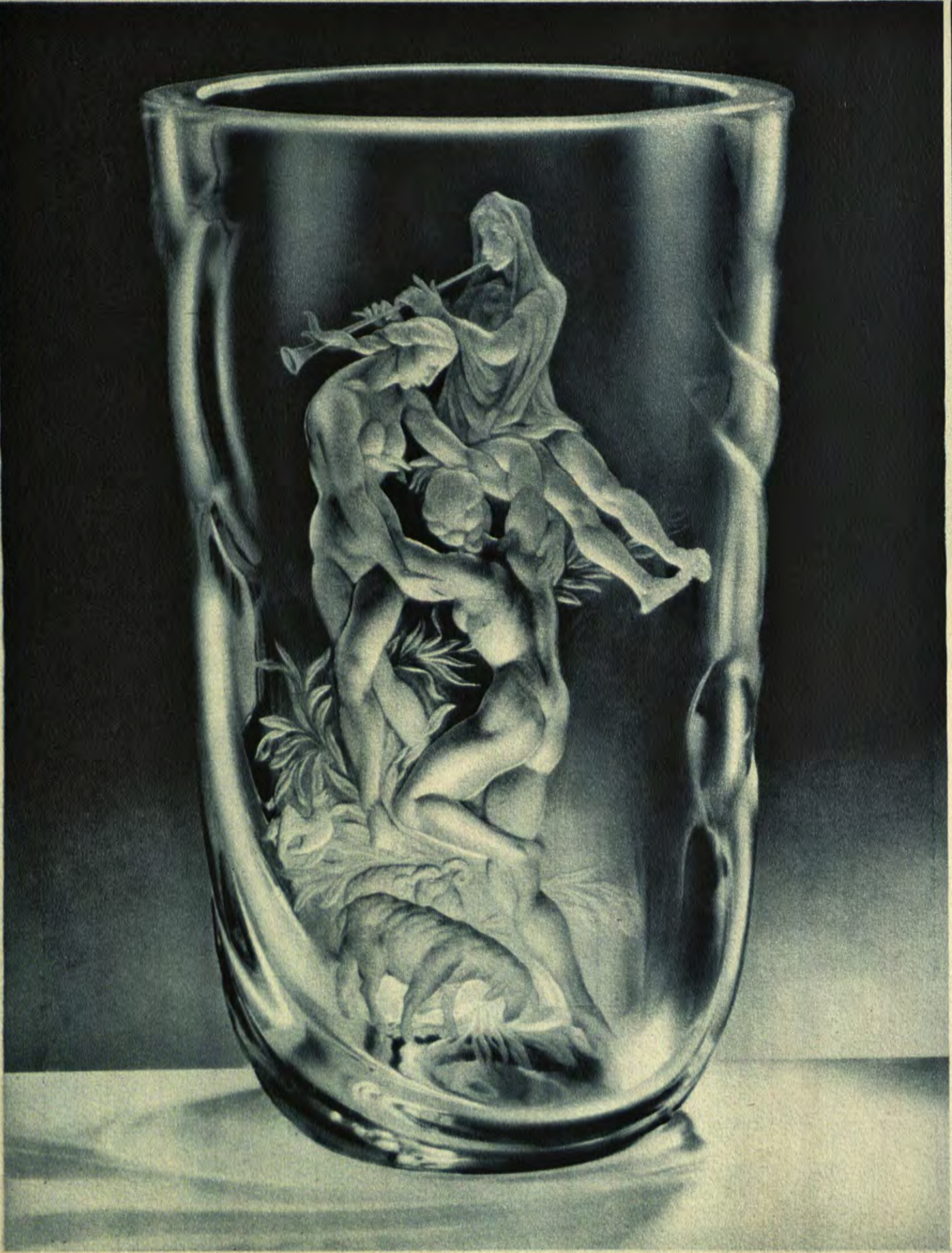
399. Prof. Stanislav Libenský: "Pelicans". Etched Dish. Higher Arts and Crafts School for Glass-Making in Nový Bor. 400. Miroslav Janků: Cut and Painted Beaker. 1949. 401. Jiřina Pastrnková: Etched and Painted Dish. Železný Brod. Photo: Honty, Prague.



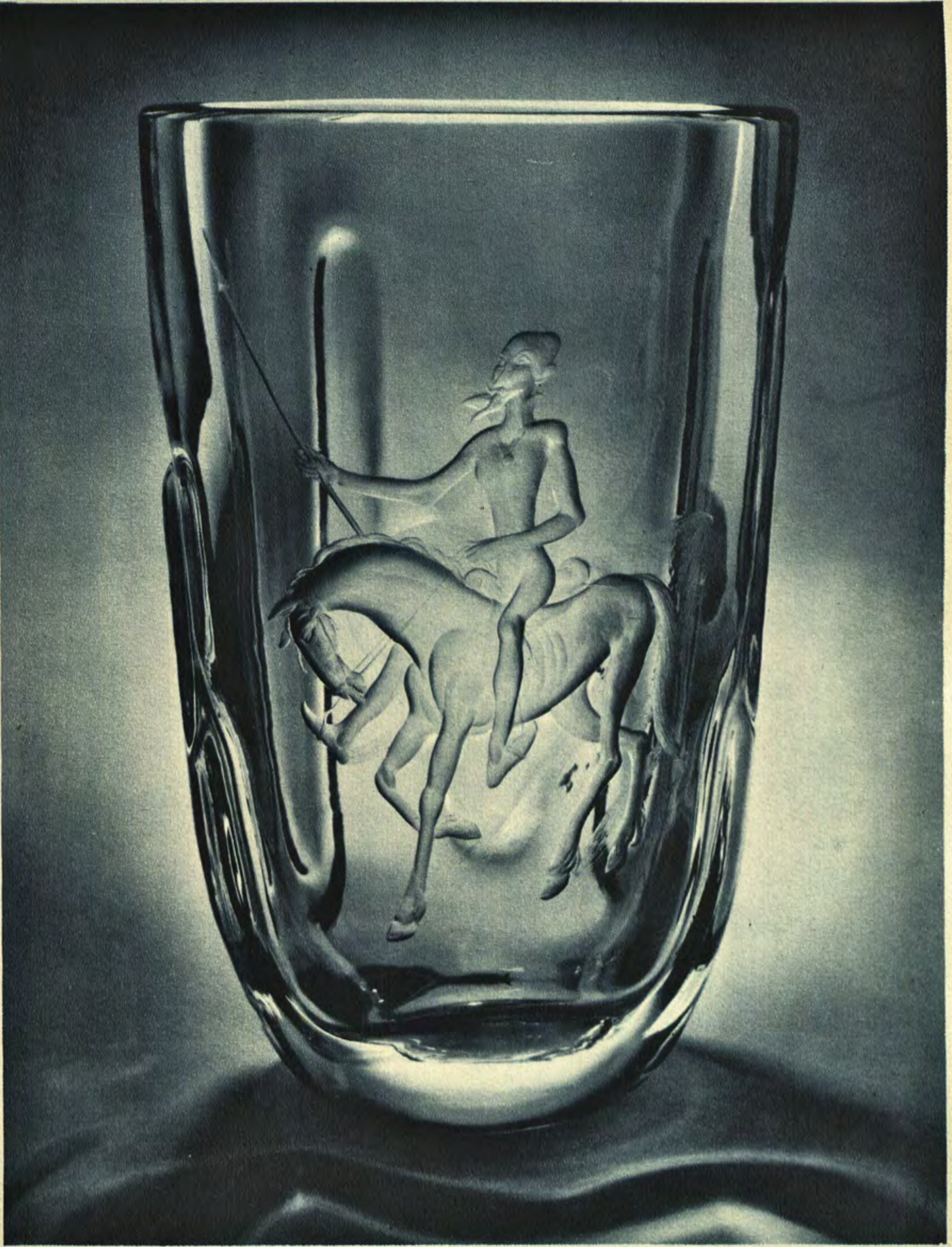
402. Miroslav Janků: "Autumn". Etched and Painted Jardinière. Photo: J. Brok, Prague.



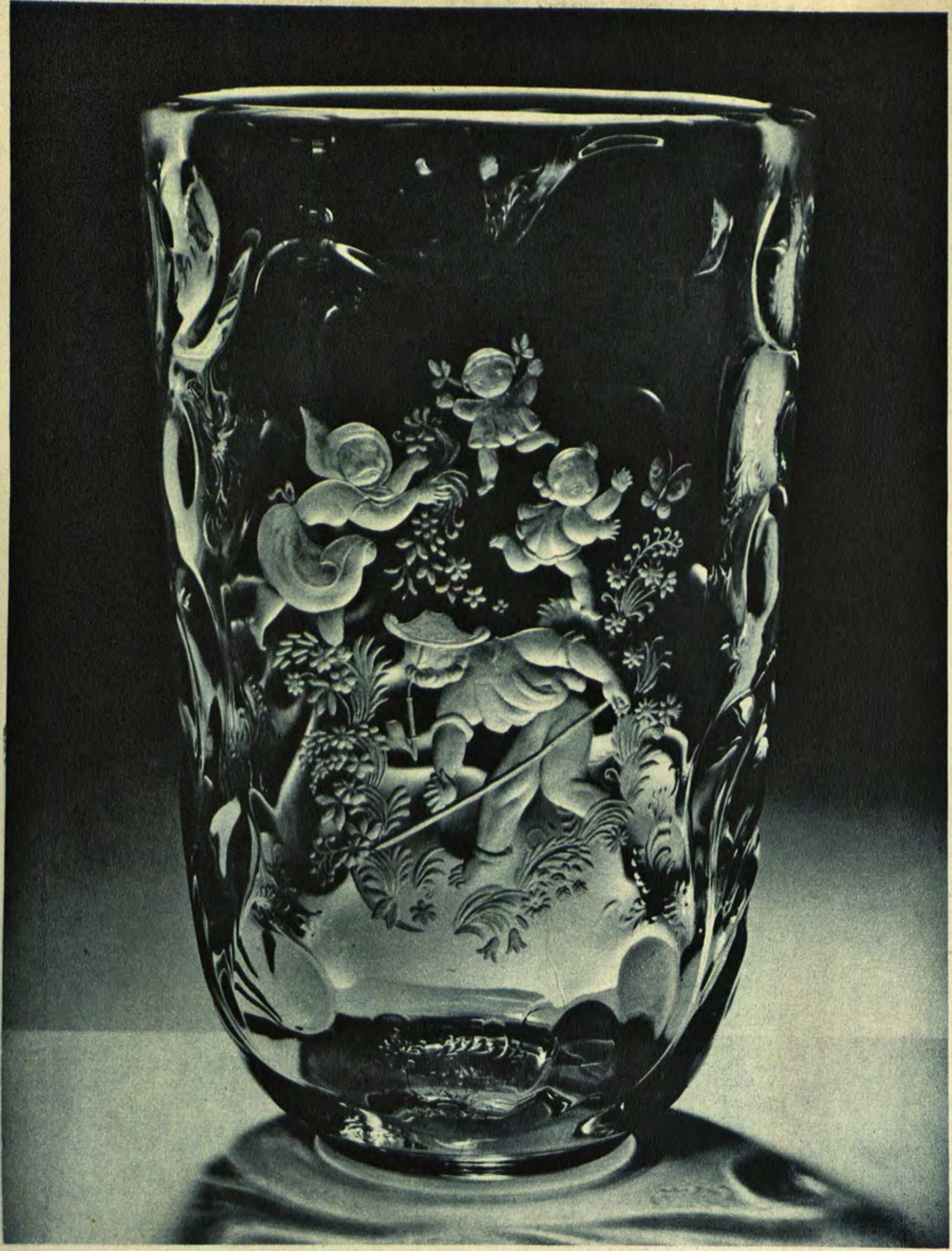
403. Prof. Stanislav Libenský: "The Hussite Army" Etched and Transparent, Painted Vase. Executed by "Artistic Glass" N. E. Nový Bor. 1953. Photo: J. Brok, Prague.



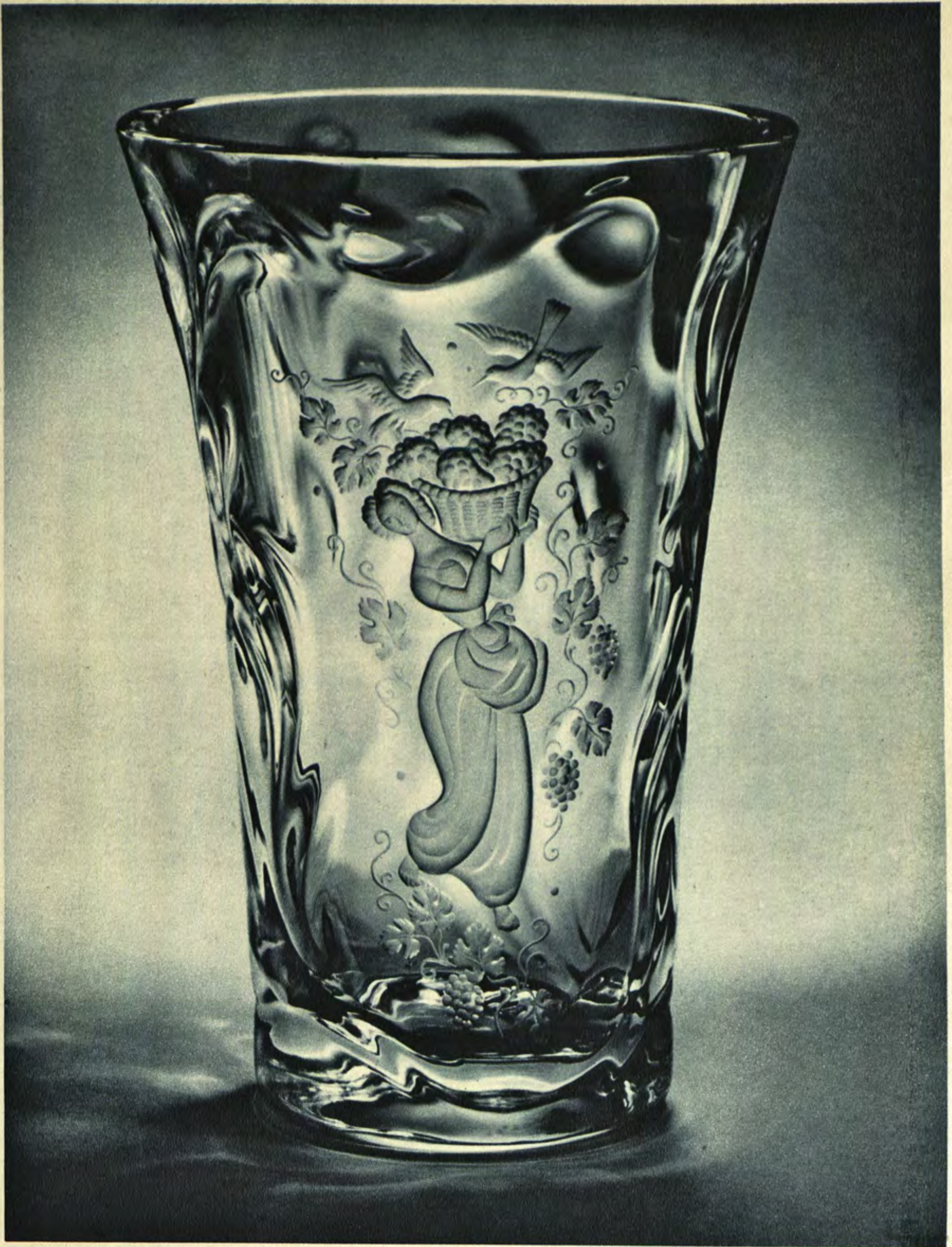
404. Jindřich Tockstein: "The Last Judgment". Železný Brod. 1943. Photo: J. Brok, Prague.



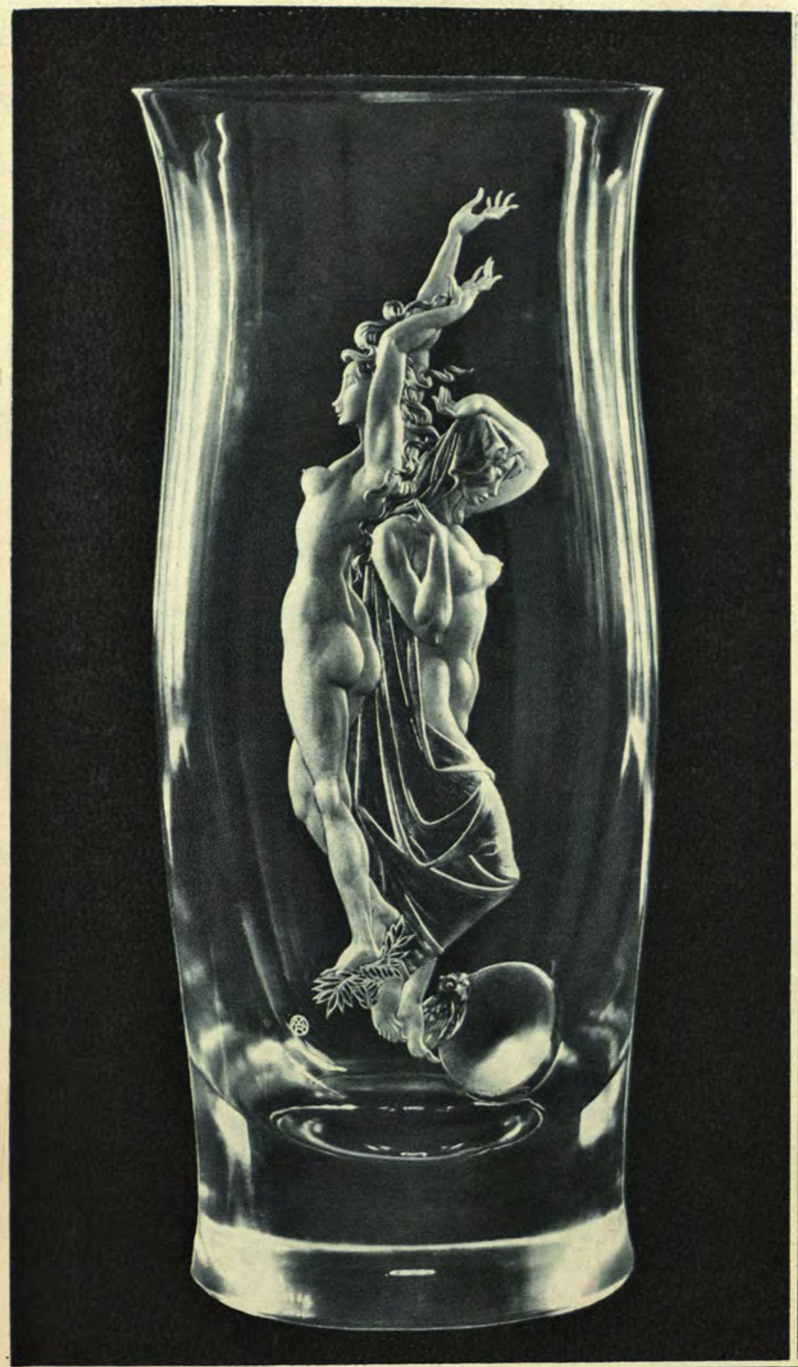
405. J. Tockstein: "Don Quixote". Photo: J. Brok, Prague.

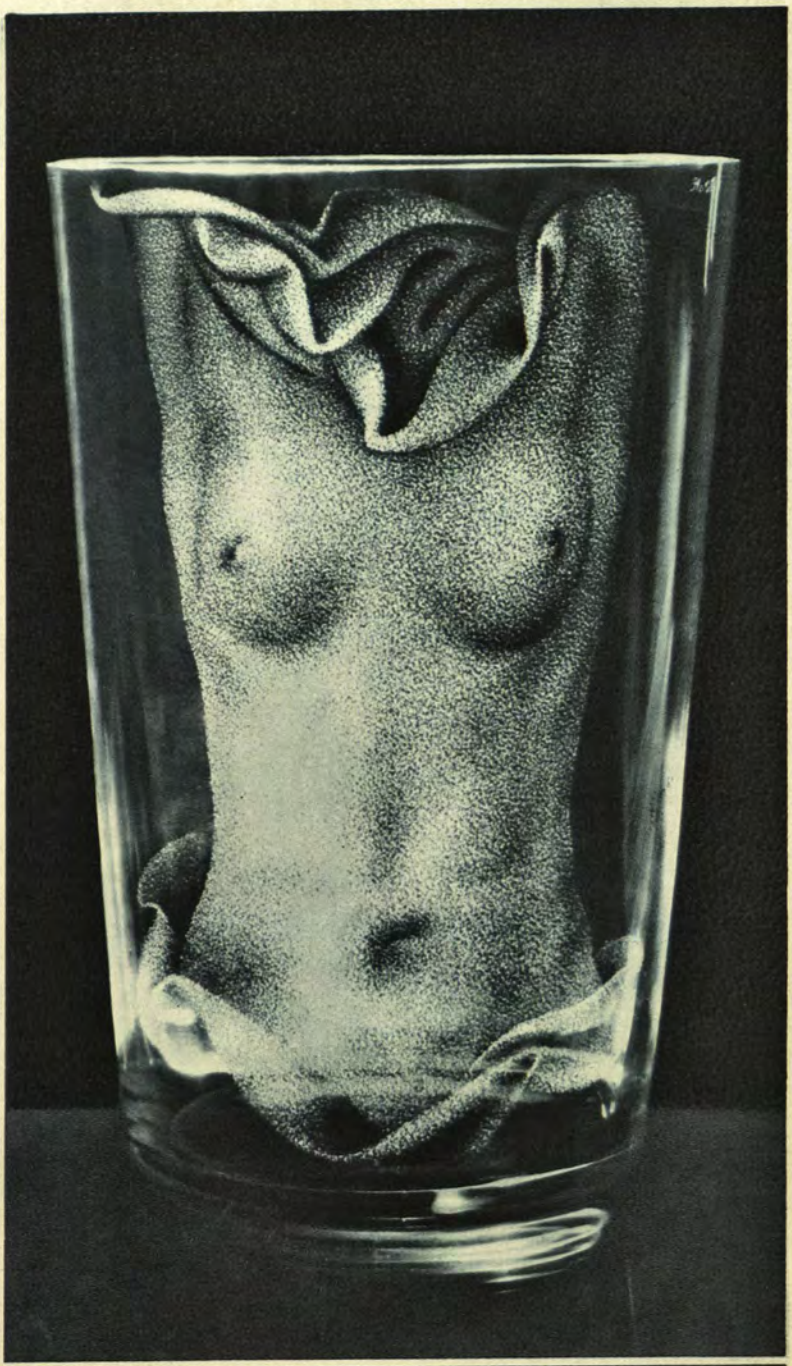


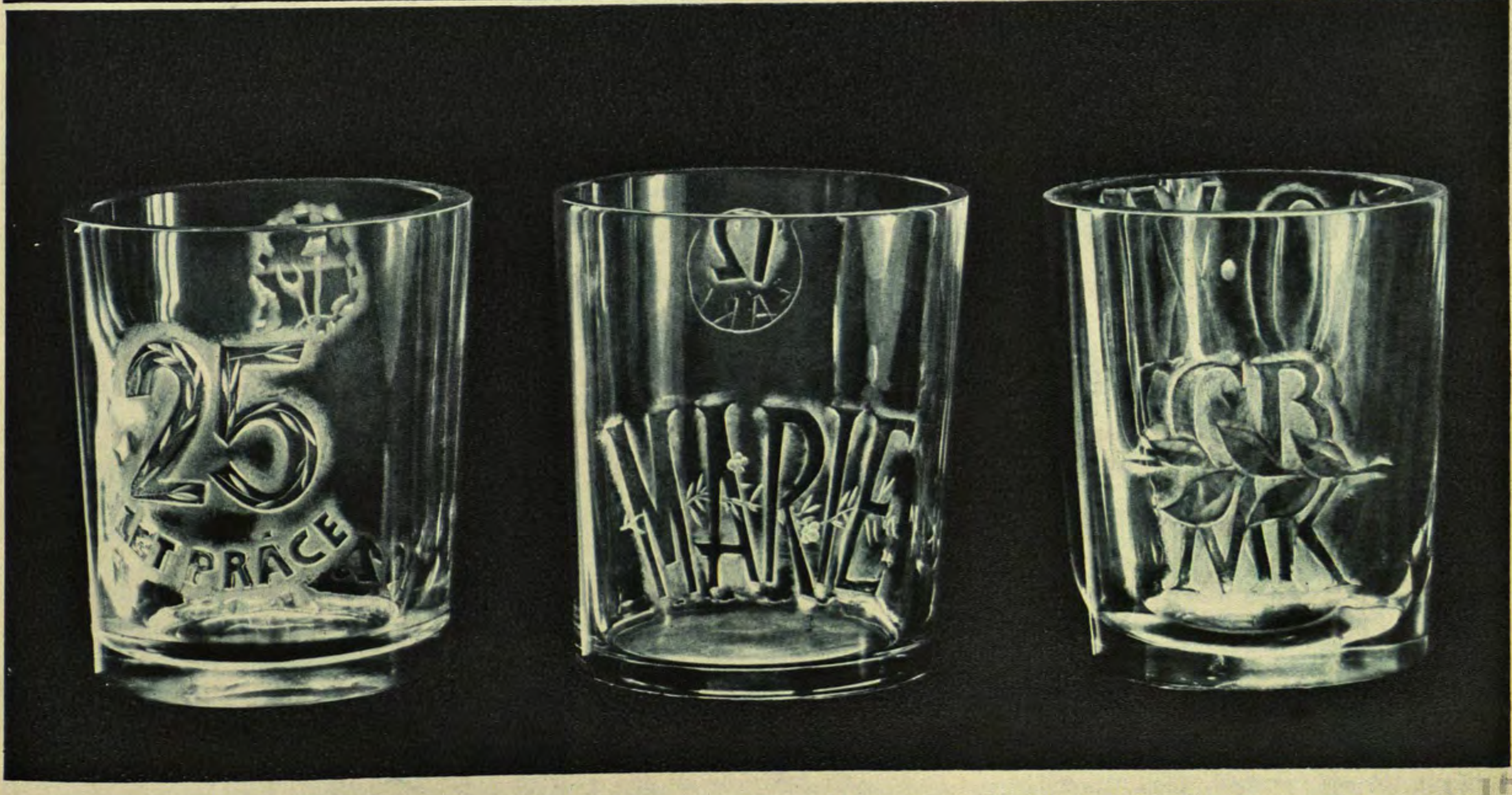
406. *Prof. Božetěch Medek: "Hay-making". Cut and Engraved Vase. Železný Brod. 1945. Photo: J. Brok, Prague.*



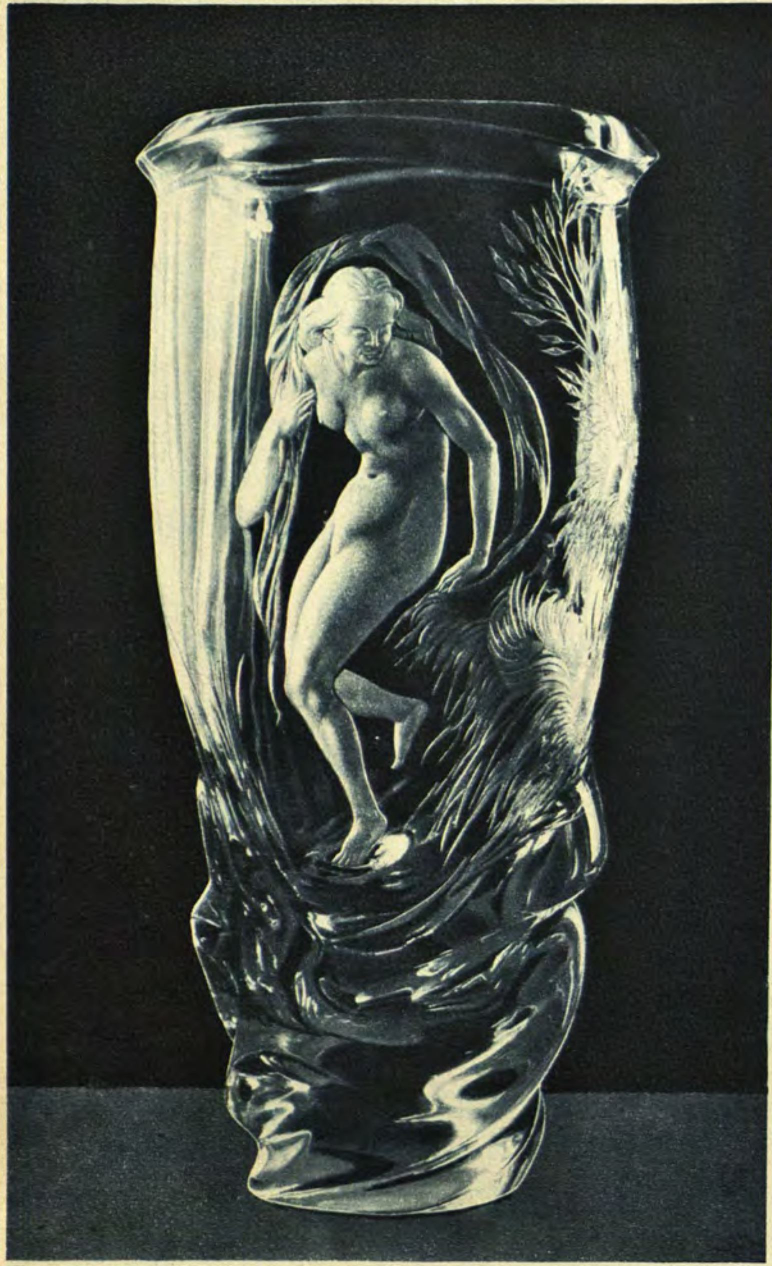
407. *Prof. Božetěch Medek: "Girl with a Basket of Grapes" Cut and Engraved Vase. Železný Brod. Photo: J. Brok, Prague.*

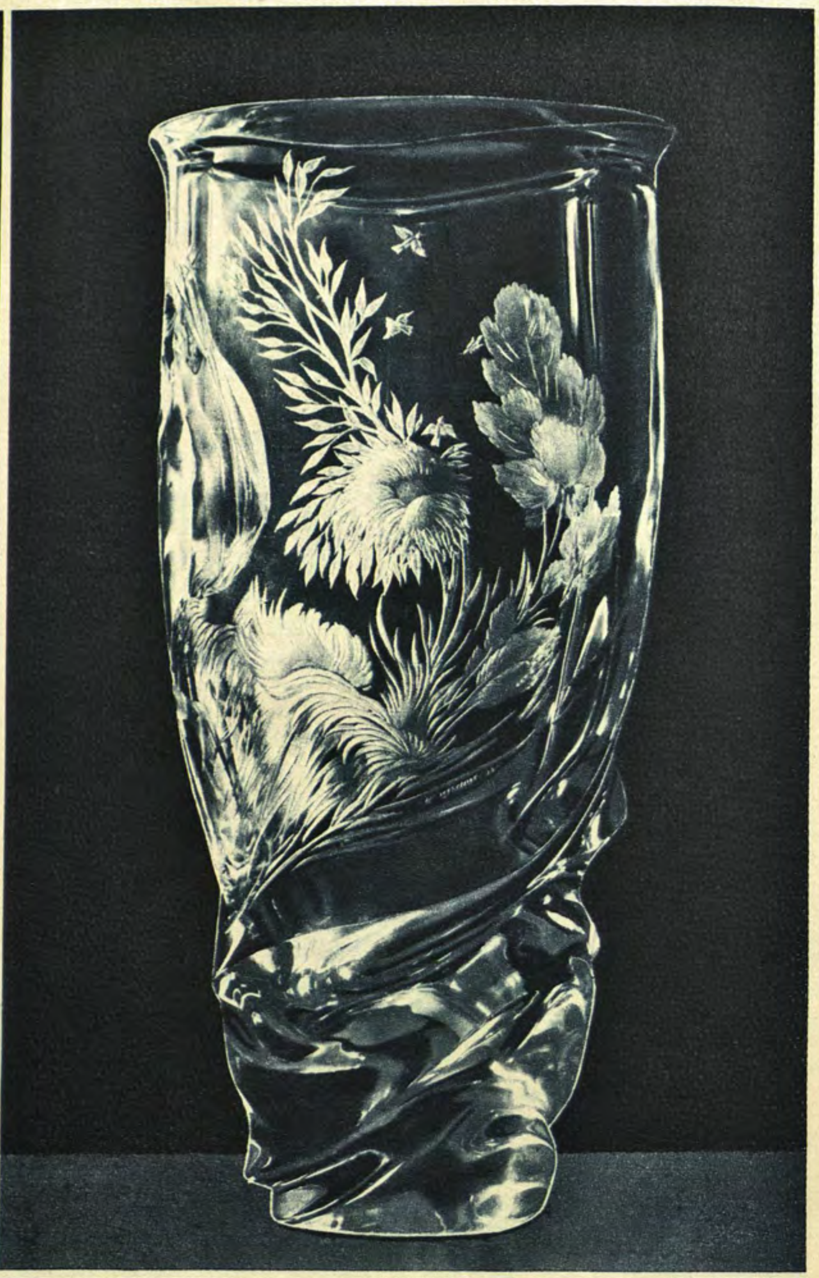


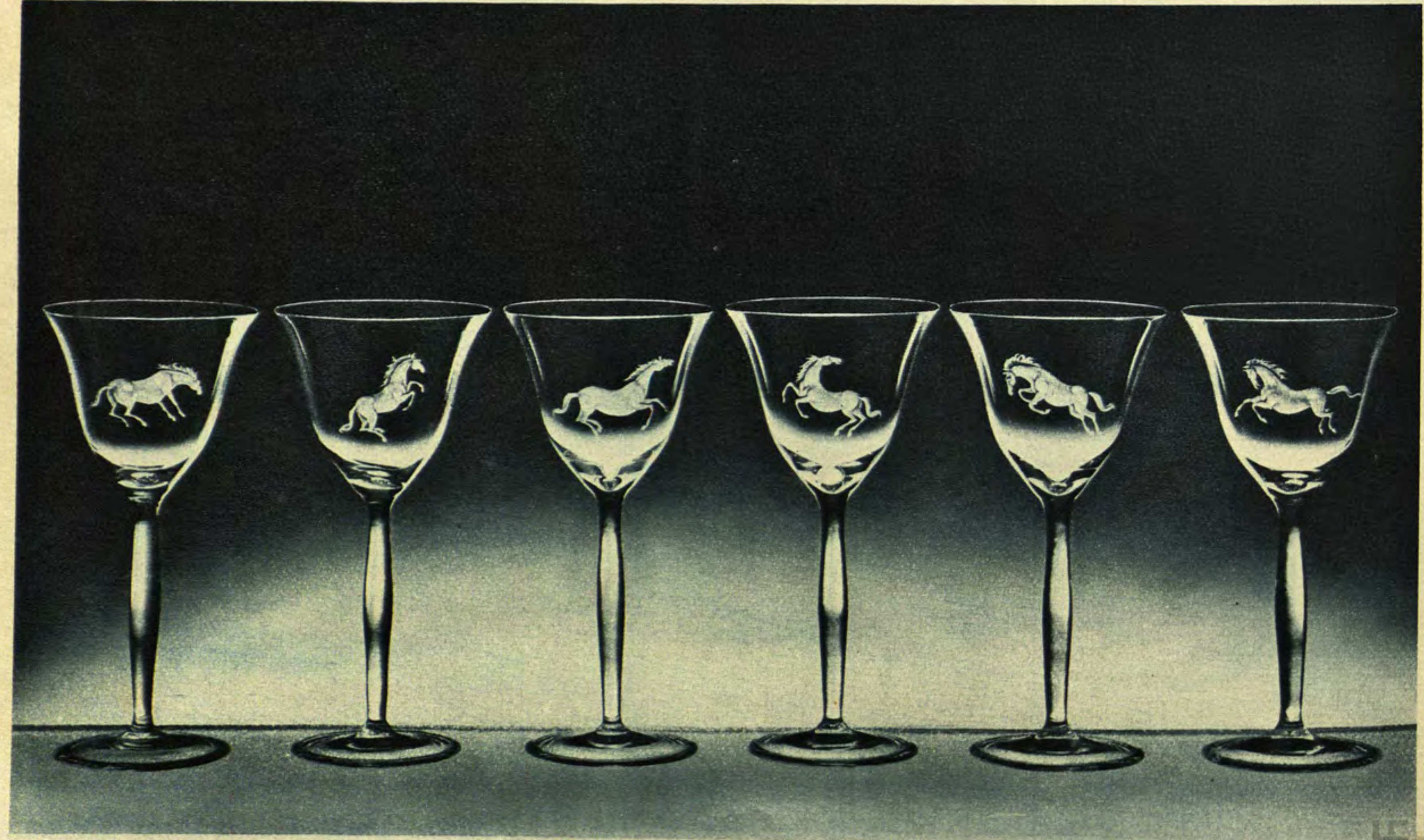




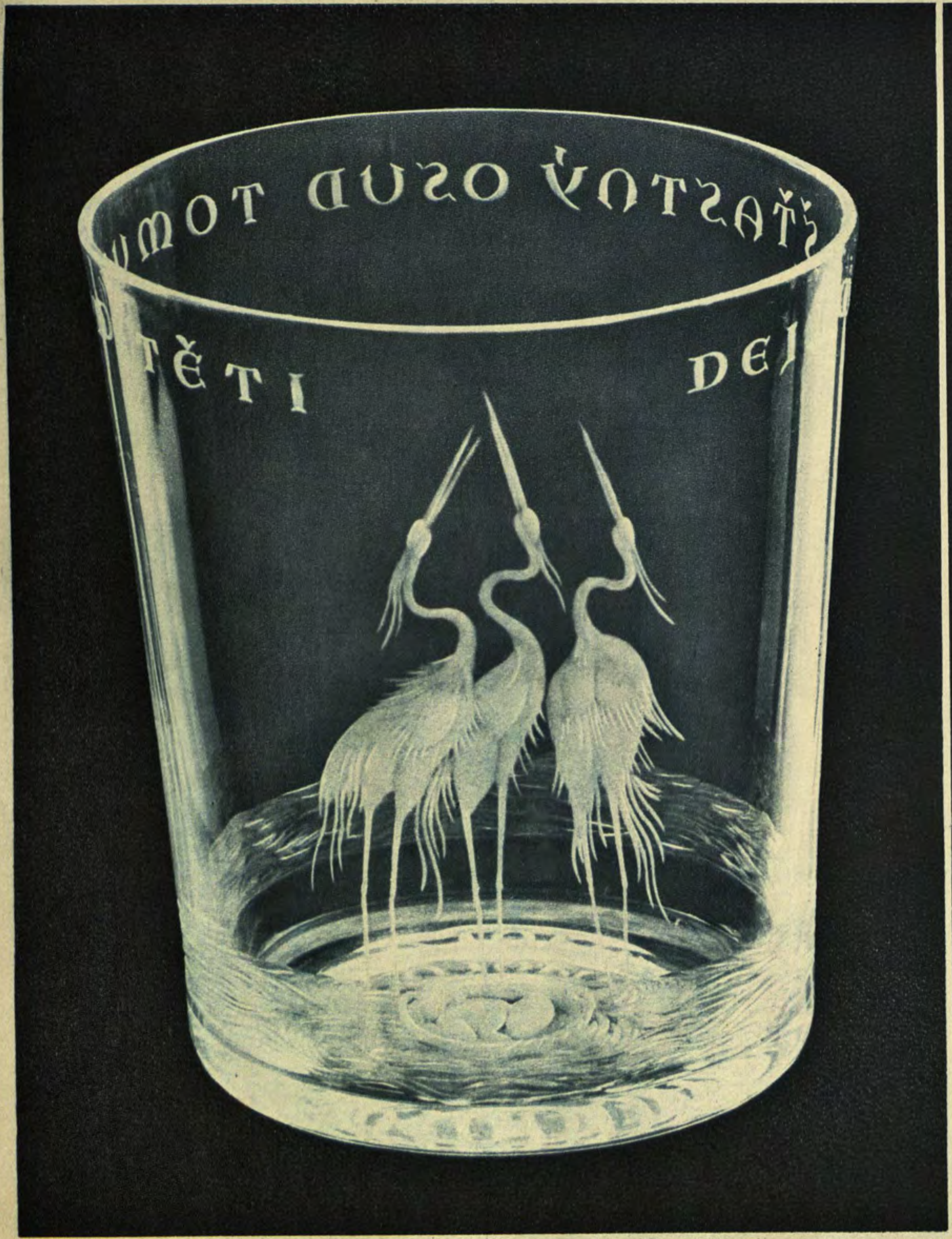
408. Václav Plátek: "Day and Night" Engraved Vase. "Artistic Glass", N. E. Lobmeyr Works, Kam. Šenov. 409. V. Plátek: Diamond-Stippled Vase. (PACM) 410. Three Souvenir Goblets in Relief-Cut Crystal-Glass. The first two by Maria Stáhlíková, the third by Milena Korousová.



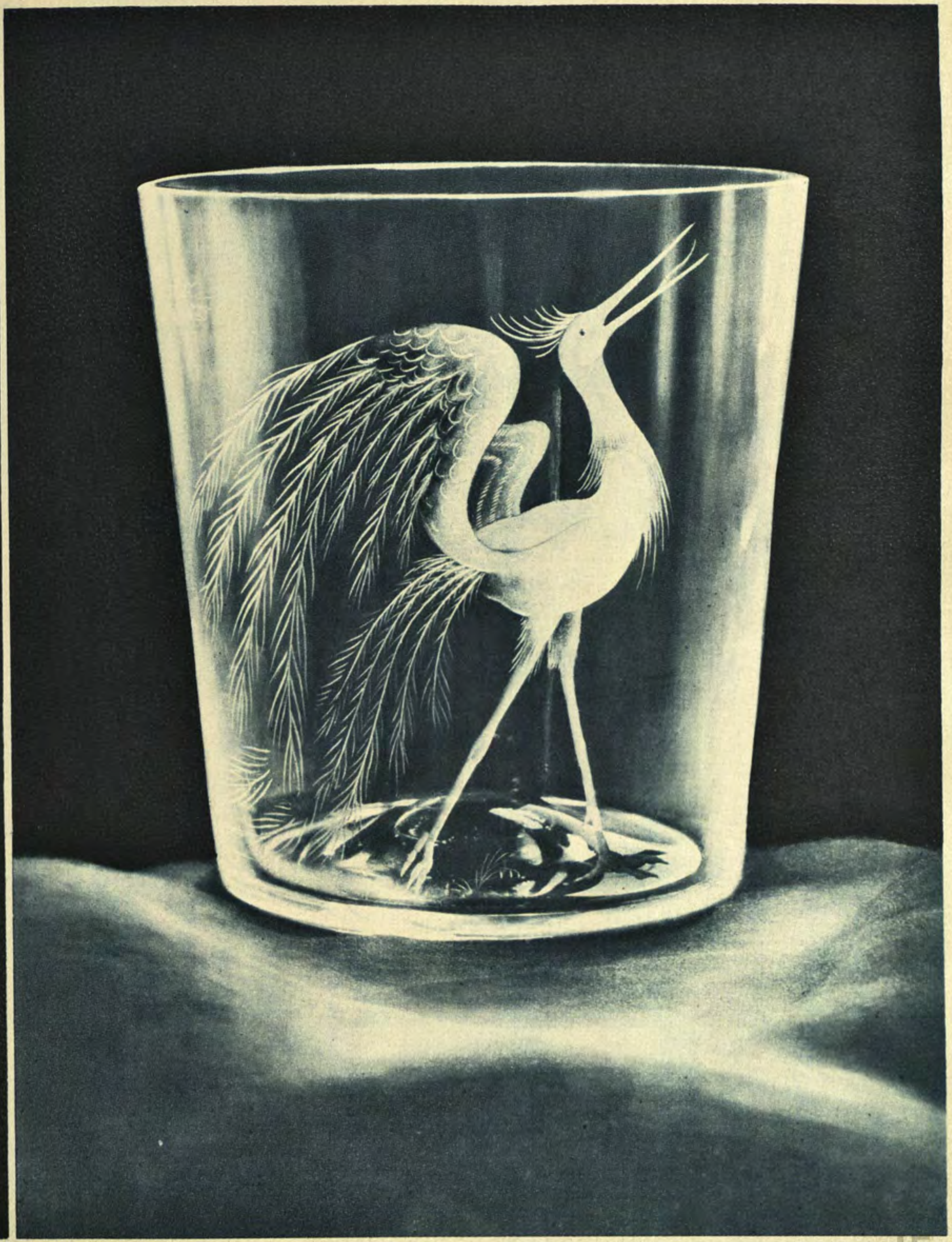




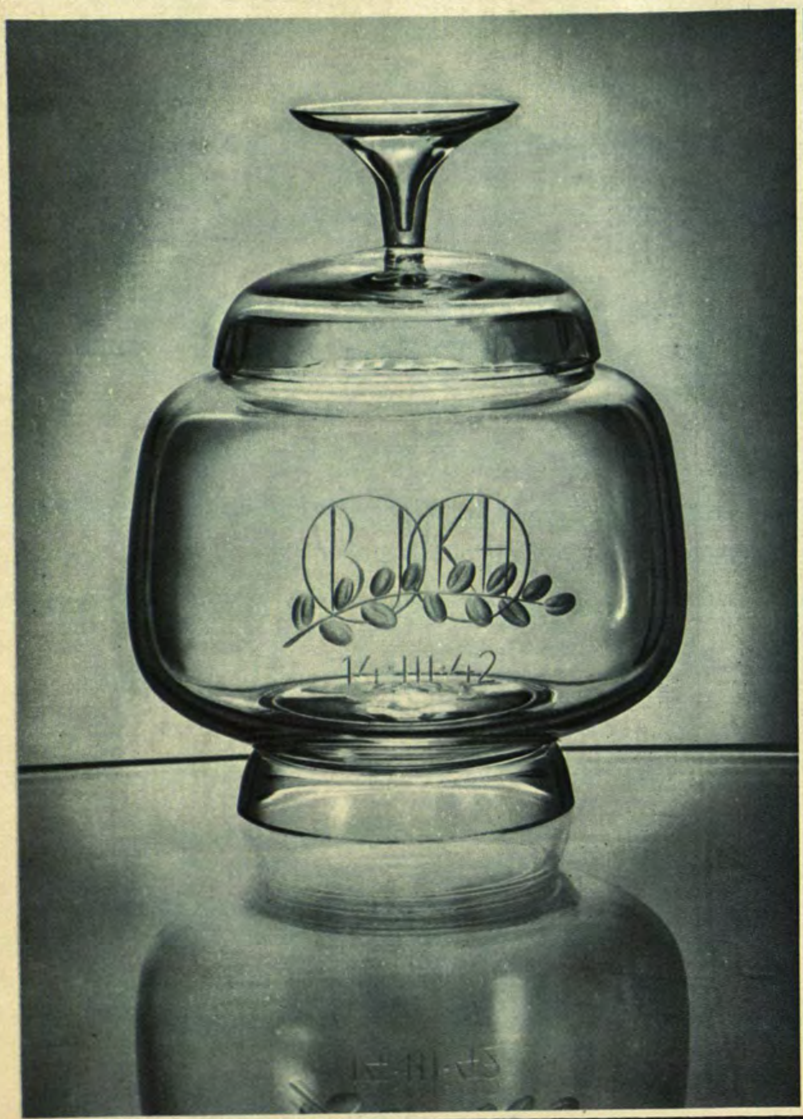
411.—412. Prof. René Roubíček: "The Bathe". Engraving by Kurt Bischof. "Artistic Glass" N. E. *Nový Bor. Photo: J. V. Maruška. Kam. Šenov. 413. Arch. Metelák-Tockstein: Horse-Riding on Beakers. Železný Brod. 1946. Photo: J. Brok, Prague.*

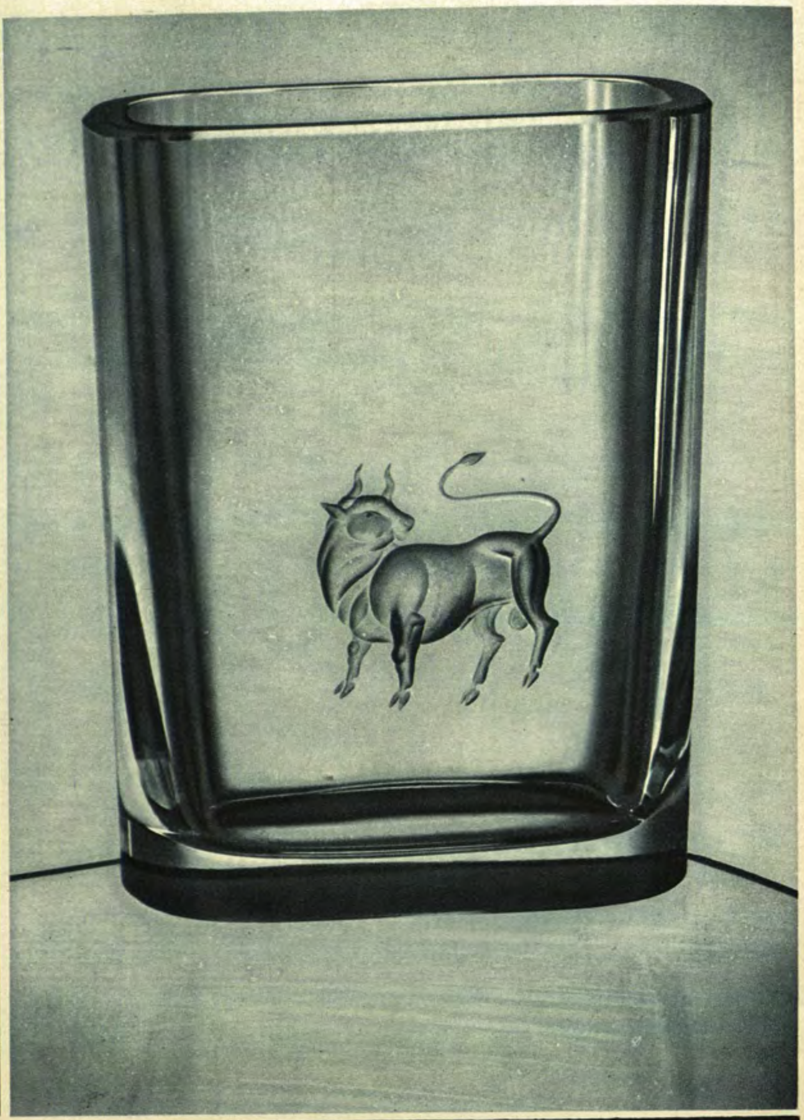


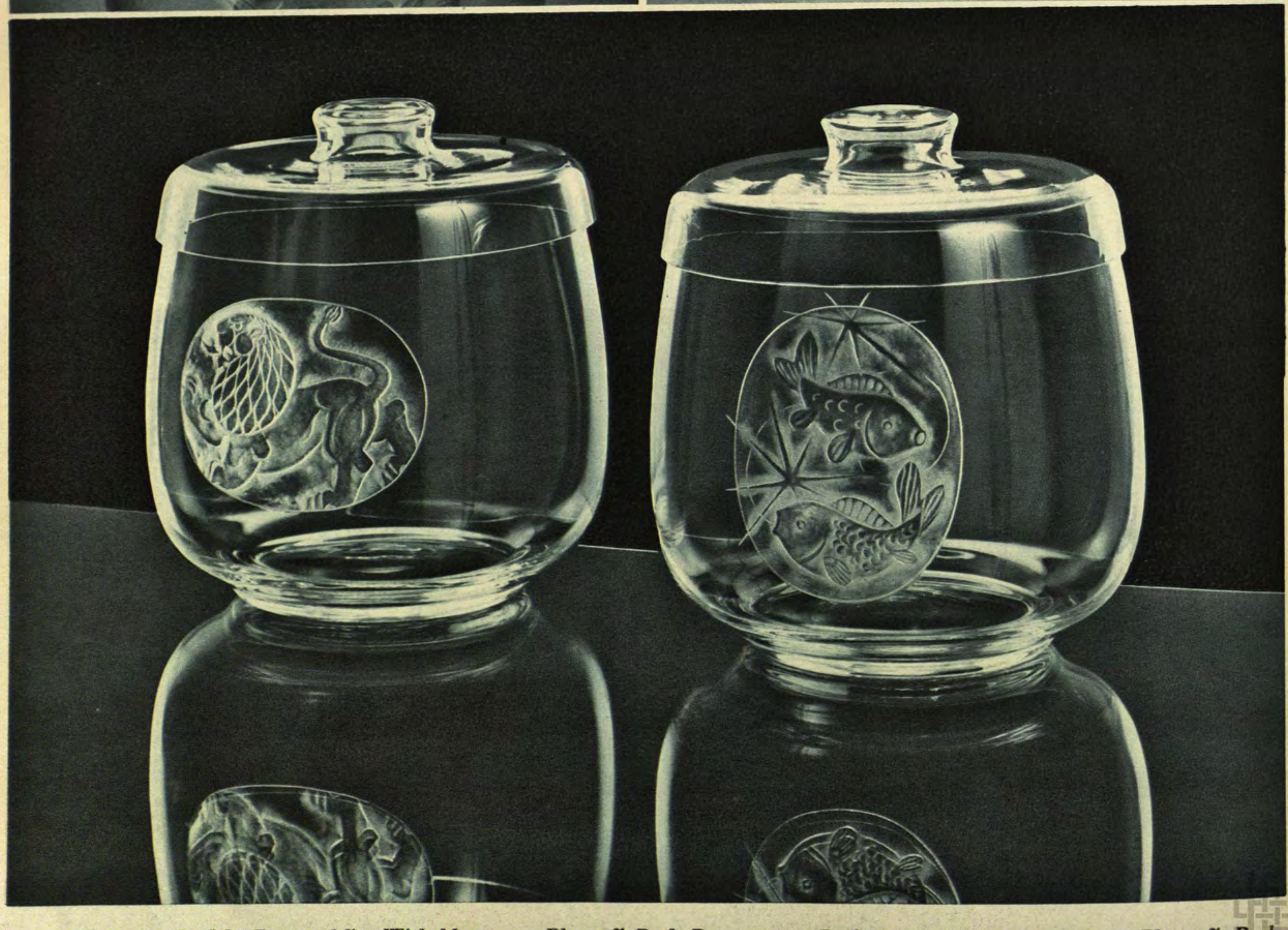
414. *J. Straková: Engraved Souvenir Beaker. ÚLUV. Photo: J. Otto.*



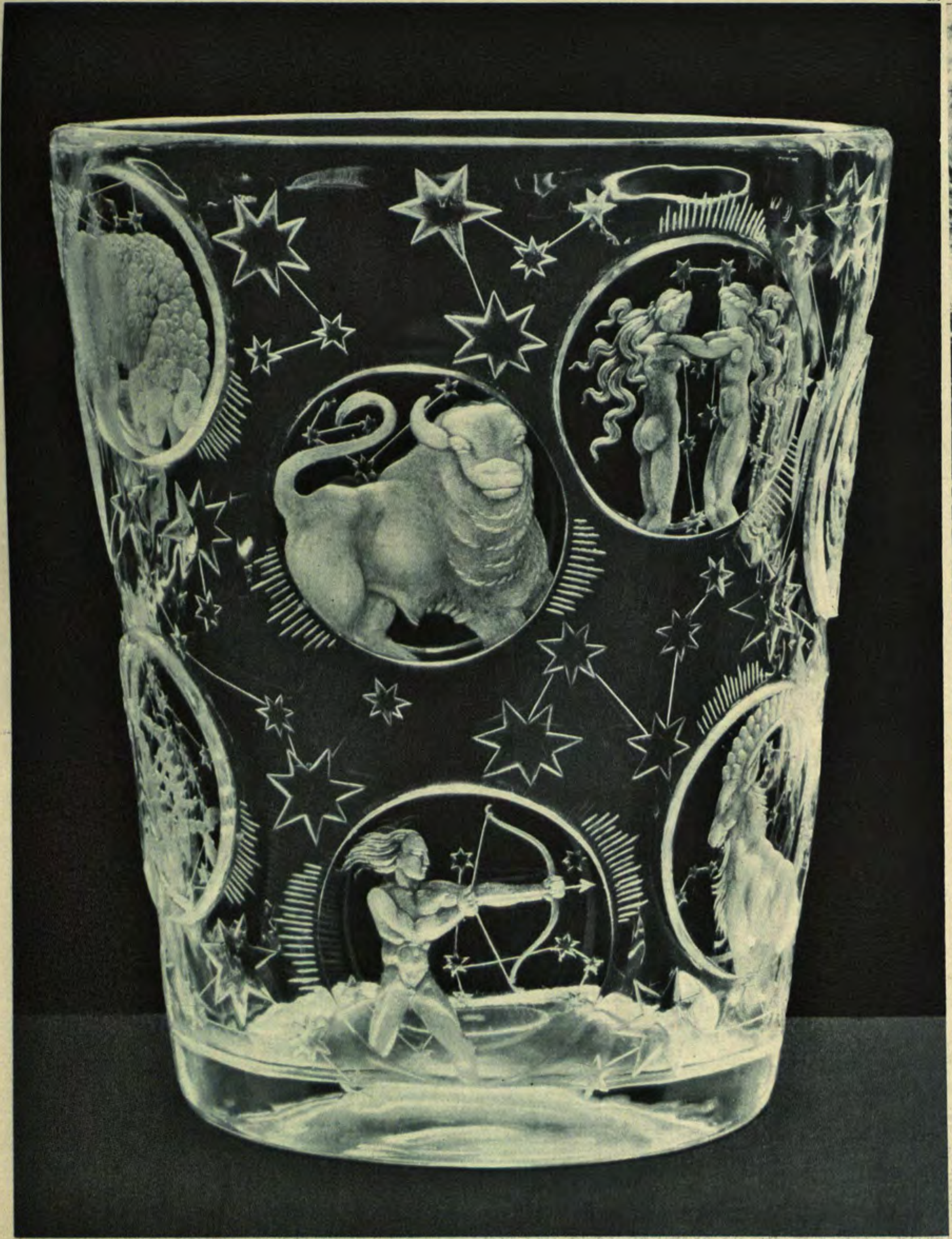
415. *Věra Lišková: Engraved Souvenir Beaker. Photo: T. Honty, Prague.*



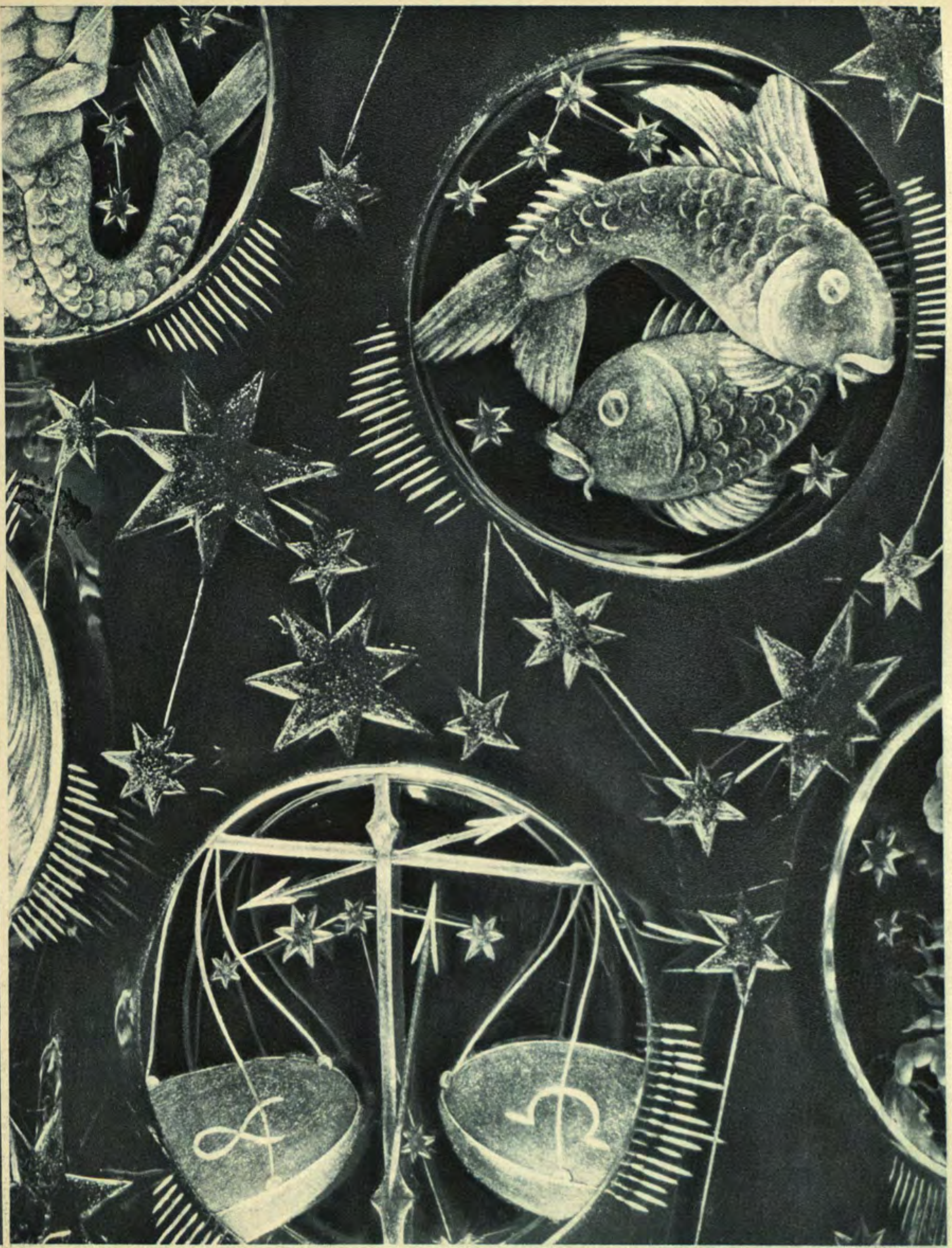




416. Prof. Karel Hrodek: Engraved Jar With Monogram. Photo: J. Brok, Prague. 417. Prof. K. Hrodek: Engraved Vase. Photo: J. Brok, Prague. 418. Prof. K. Hrodek: Engraved Jars. Photo: Jaroschy.

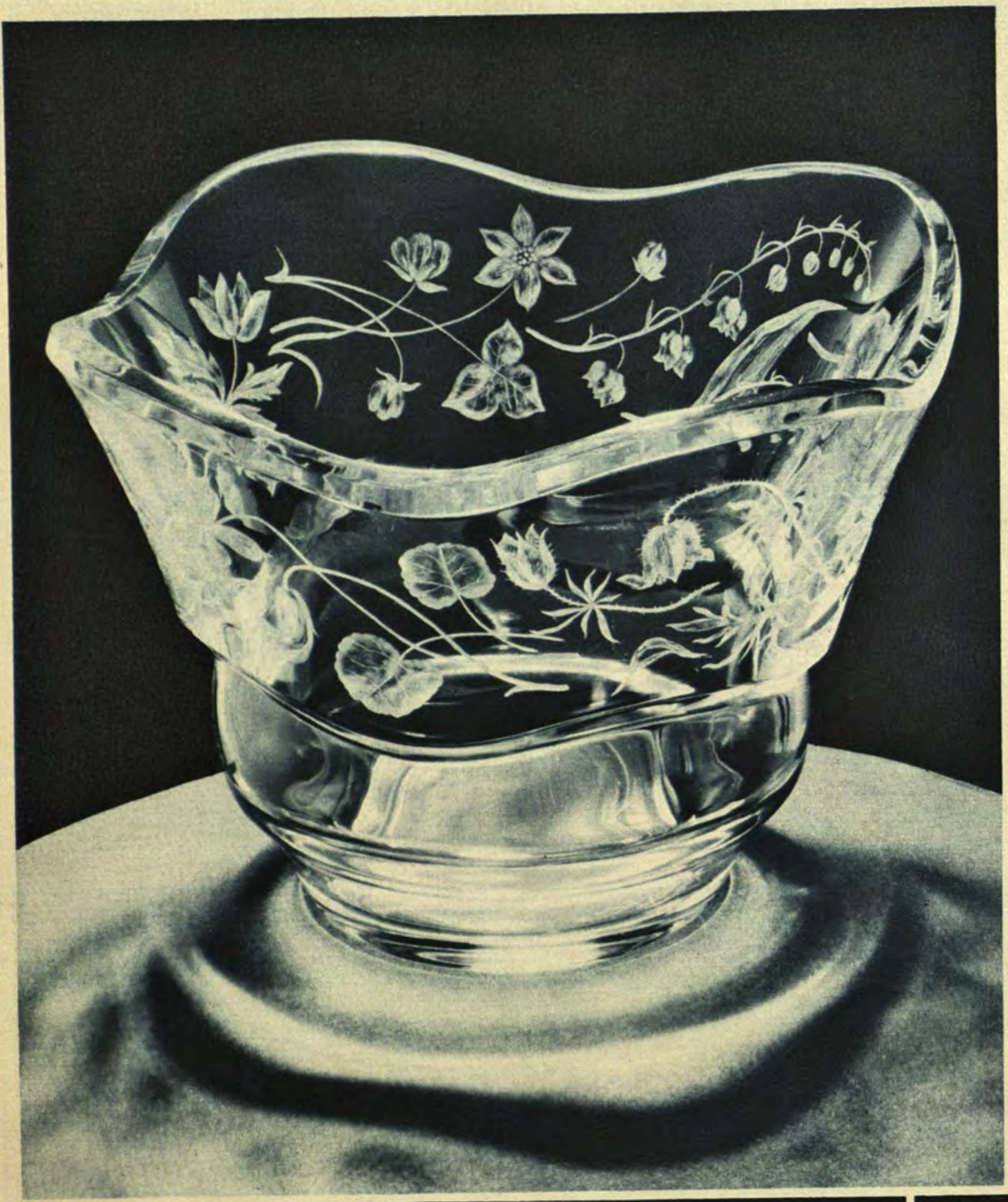


419. Věra Lišková: Beaker with Zódiac Signs. Photo: J. Brok, Prague.

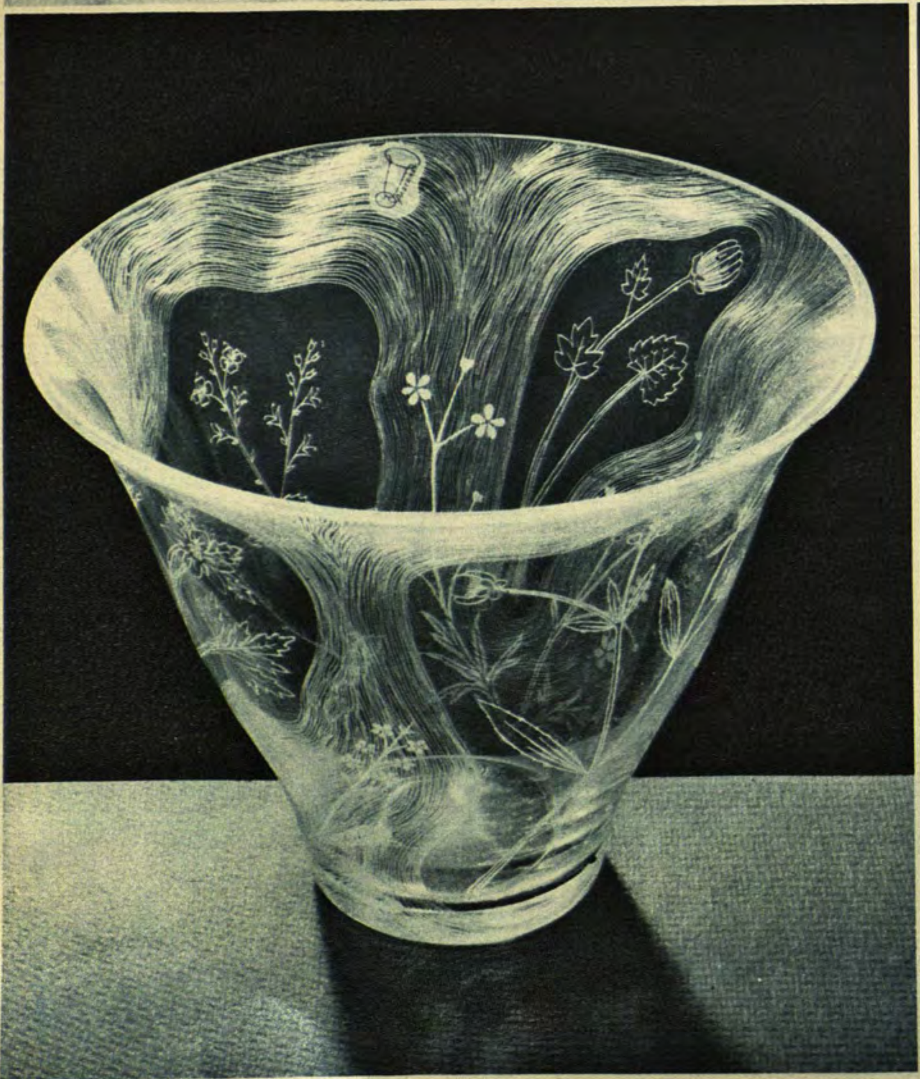


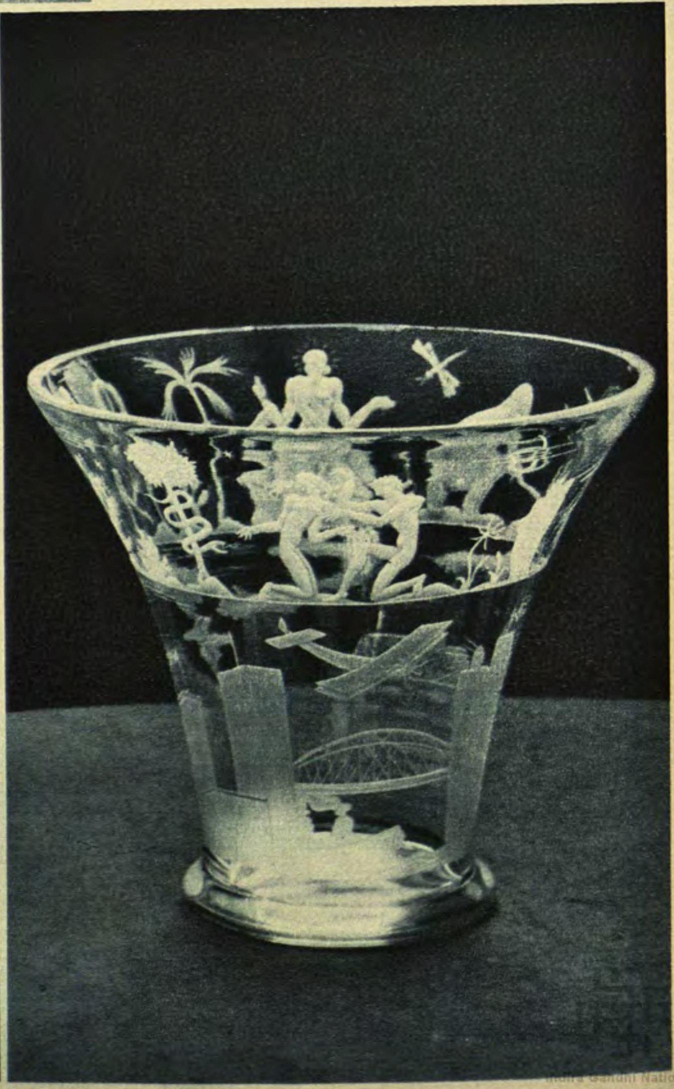
420. Věra Lišková: Detail of the Previous Engraving. Photo: J. Brok, Prague.

421. Ludvika Smrčková: Cut-Glass Vase with Engraving. Karlovy Vary Glass, N. E. 1950. Photo: J. Brok, Prague.

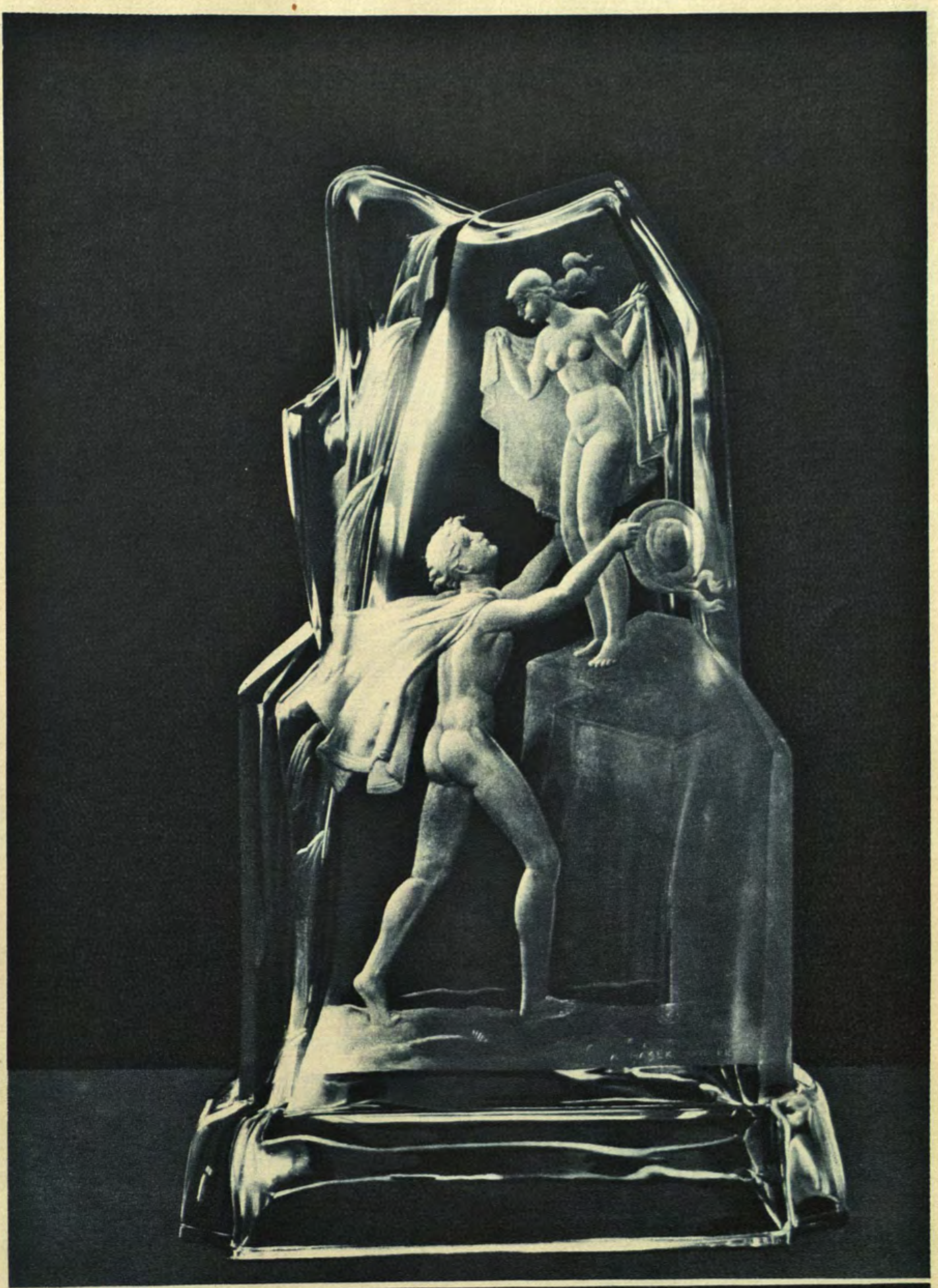


422. Jiřina Pastrnková: Cut and Engraved Vase. Železný Brod. Photo: J. Brok, Prague.
423. Oldřich Žák: "Creation". 1930.

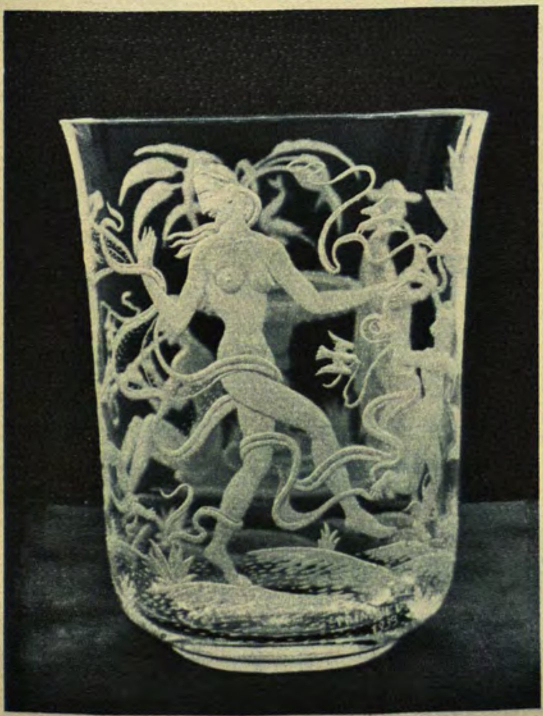


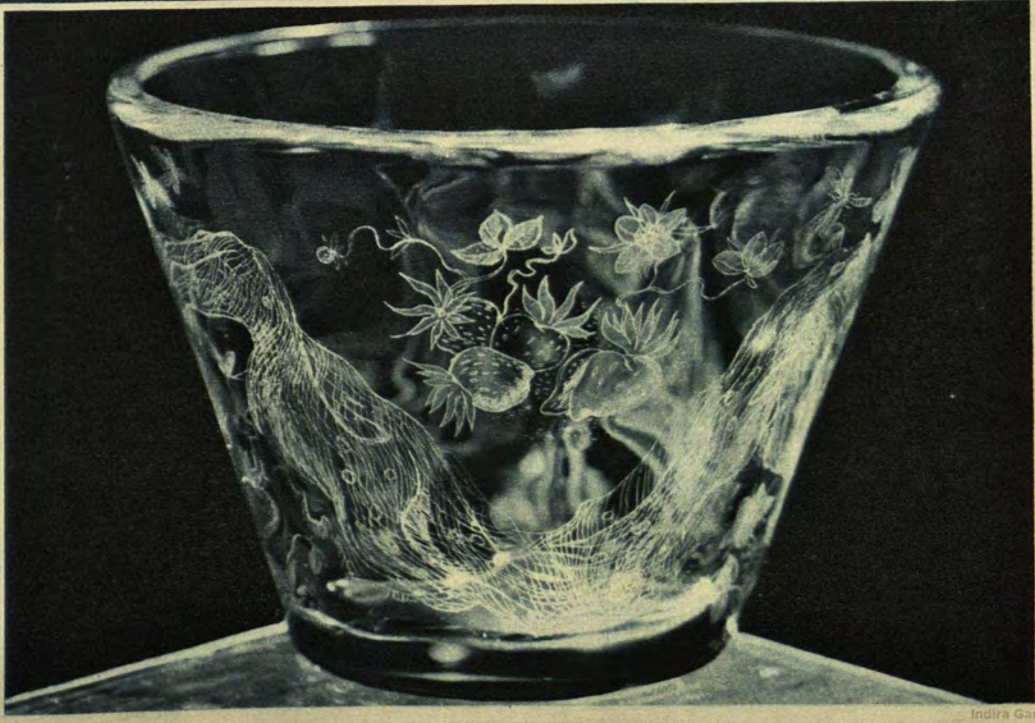


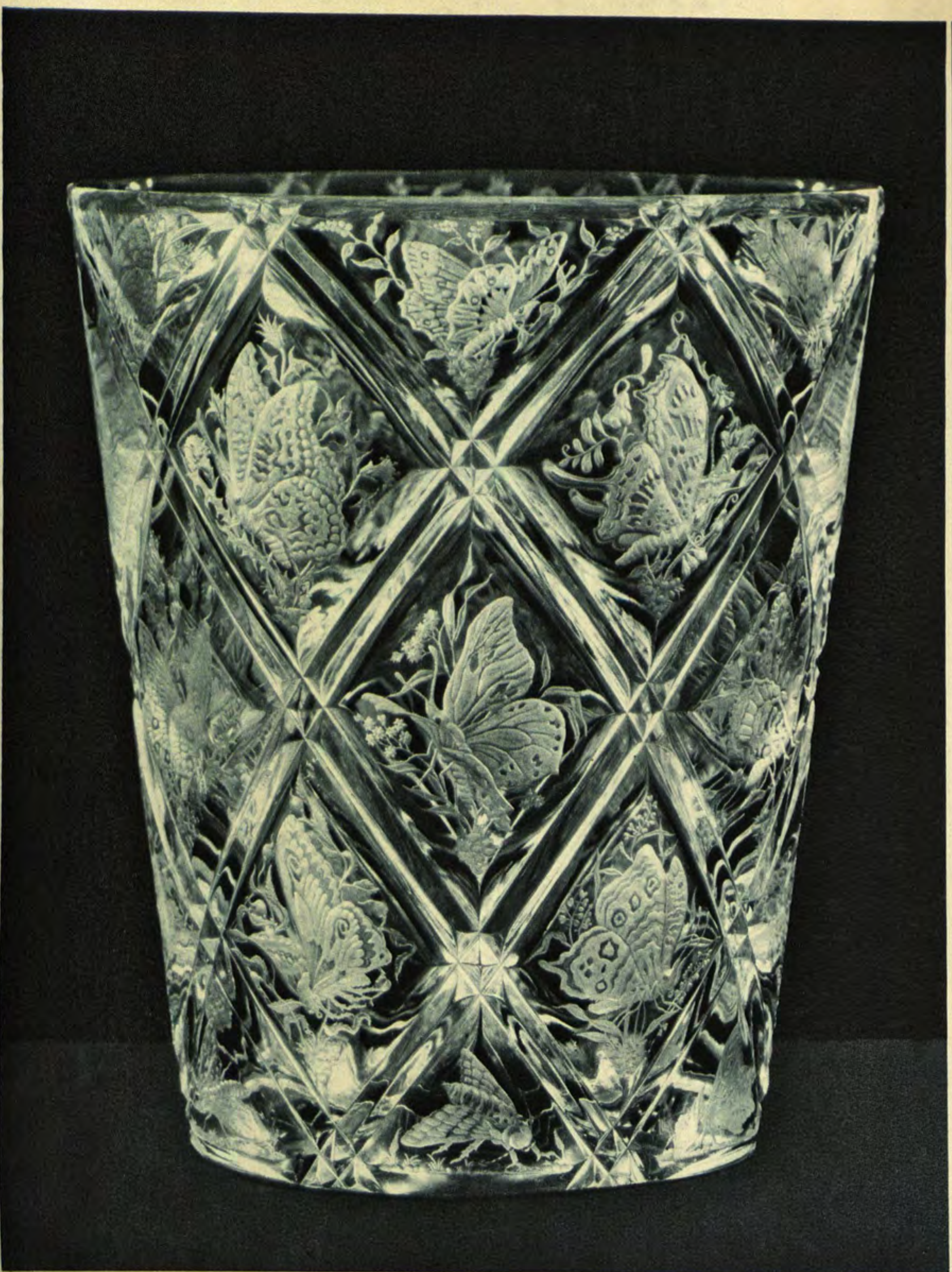
424. Alois Hásek: Crystal Paper Weight, Engraved During his Apprenticeship with Prof. Drahoňovský. 1929.



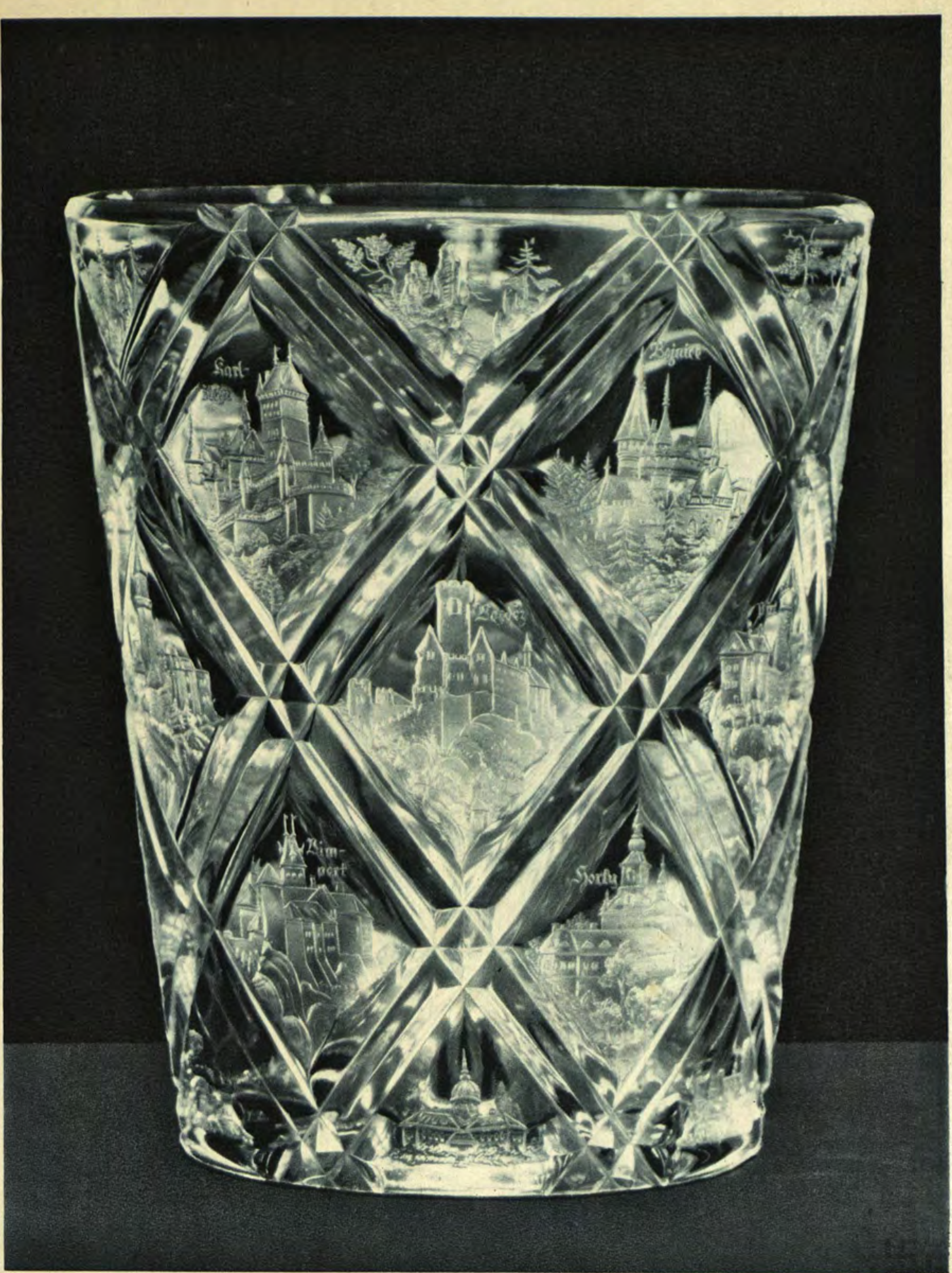
425. L. Přenosil: Engraved Crystal Glass. Železný Brod. Photo: A. Dubský. 426. Milan Metelák: Crystal Dish with Dull Drawing. Železný Brod. Photo: J. Hilger, Železný Brod.



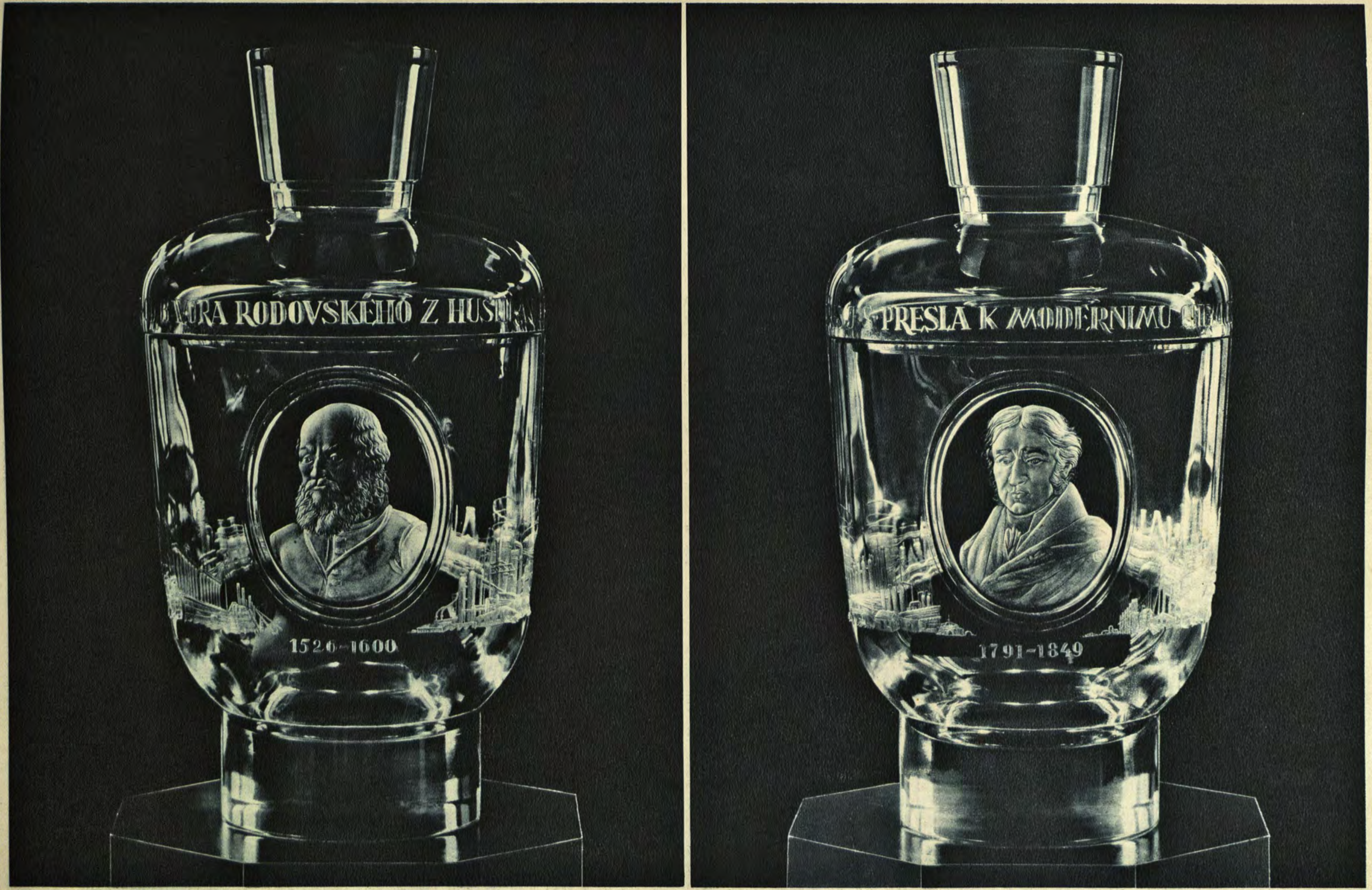




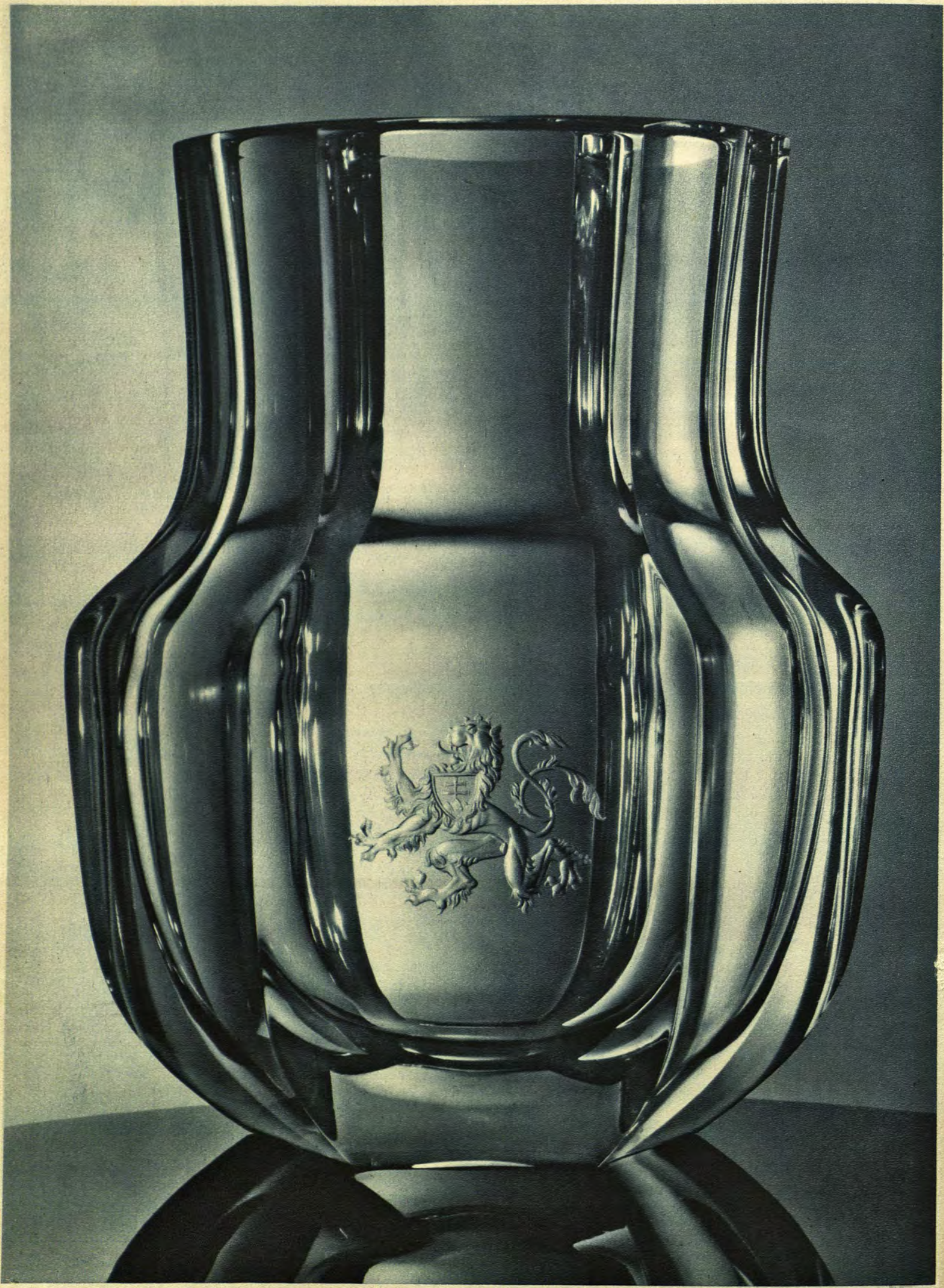
427. *Erika Hellerová: Cut Drinking Glass with Intaglio-Engraving. "Butterflies". Engraved by J. Lauda, Cut by F. Kořista. "Artistic Glass", N. E. Lobmeyr Works, Kam. Šenov. Photo: J. V. Maruška, Kam. Šenov.*



428. *Erika Hellerová: Cut Drinking Glass with Intaglio-Engraving "Castles and Forts", Engraved by J. May, Cut by F. Brabec. Photo: J. V. Maruška, Kam. Šenov.*



429. Erika Hellerová - Prof. J. Lipská (Straková): Cut Beaker with Intaglio-Engraving of the Portraits of Bavor Rodovský of Hustiřan (1526—1600), J. S. Presl and a Motif of a Chemical Works. Portrait Engraving by E. Bischof, Factory Drawing and Inscription by R. Kolrus. Cut F. Kořista, Portrait Design Prof. Lipská-Straková. Photo: J. V. Maruška, Kam. Šenov.



430. Václav Plátek: Cut and Engraved Hexagonal Crystal Vase with the State Symbol of Czechoslovakia. Engraved by Miroslav Plátek. Železnobrod Glass, N. E. Photo: J. Brok, Prague.

EXPLANATIONS

Abbasids — descendants of Mohammed's uncle who were exiled under the rule of the first caliphs; they finally gained power in Damascus and changed the seat of government to Bagdad which they founded. This dynasty produced 37 caliphs who ruled till 1258 when Bagdad fell to the Mongols.

Abd-er-Rachman — invited Byzantine mosaic workers to decorate the mosque in Cordoba (Spain) in 750 A. D.

Aeneas Sylvius Piccolomini — eminent lord of the Church who took part in a German punitive expedition against the Hussites; later became Pope Pius II, born 1405, died 1464.

Agricola Georg — the name means "Farmer" — born 1494, died 1555, was the founder of the science of glass-making in Germany. He was born at Glauchau in Saxony, was Rector of the Latin School in Zwickau in 1518, then went to Italy where he gained the Doctor of Medicine degree at Ferrara. He returned to Germany in 1526, a year later became physician in Jáchymov where in his leisure time he devoted himself to mineralogy and published his first work with the permission of Erasmus of Rotterdam (in Basle). In 1533 he became doctor and later also mayor of Chemnitz where he unexpectedly died of a stroke. His most popular work, which went through many editions, dealt with mining and glass-making.

Alkalies — or caustics, in the narrower sense, are compounds of oxygen or also compounds of oxygen and hydrogen with different metals, such as soda, potassium etc. The Arabs used this name to designate the watery solution of the ash of sea plants, ie. chiefly matters containing soda; the name was applied only at a later stage to potash, the pottasium, containing ash from inland lakes.

Amenemhet — Egyptian Pharaoh, ruled 1849—1801 B. C. Erected a huge water reservoir in Fayum as well as the famous labyrinth palace.

Amenhotep I — Egyptian Pharaoh (1575—1525) who re-united Nubya to his empire.

Amenhotep II — ruled from 1447—1413.

Amenhotep IV — Egyptian Pharaoh (in Greek Amenophis) who ruled from 1377—1361; he reformed the religion of the country, introduced the worship of a single god (Aton) who was represented by the sun and assumed the name of Echnaton (Aton is useful). He founded the town of Achetaton (today's El-Amarna) and supported the development of artistic skills. His wife was Nephertiti whose magnificent bust has been preserved in perfect condition.

Anjou — former province in S. W. France, surrounded by the provinces of Maine, Britanny, Poitou, Touraine, size about 8 000 km^2, number of inhabitants: 400 000. Capital: Angers. The ruling family of dukes died out in 1060.

Archa — the medieval Greco-latin designation for a chamber in the glass furnaces.

Assur — name of the highest Assyrian national god, also of the capital city of Assyria at an earlier date. The town lay on the right bank of the Tigris, not far from Mossul in Iraq today.

Assurbanipal — also Sardanapal (668—626) King of Assyria, who completed the subordination of Egypt, destroyed Thebes, overpowered Babylon, laid waste the Elamite Susa. He continued to rule from Ninive where he had a palace built whose archives consisted of 22 000 cuneiform tablets on which he had the most important works of his epoch recorded; he supported art and science. These tablets have been preserved and form one of the most important sources for our knowledge about life and events at the time.

Augustus (formerly Octavianus) — Roman Emperor. Born in 63 B. C. in Rome, died 14 A. D. at Nola. The first Roman Emperor.

Aurelianus — Lucius Domitius, Roman Emperor, 270—275.

Balbín Bohuslav — a Jesuit priest, famous writer and tireless fighter for Czech national interests. Born 1621.

Bassrah — harbour on the right bank of the Shatt-el-Arab, the confluence of the Euphrates and the Tigris, 90 km north of its mouth on the Persian Gulf; Bassrah was built by caliph Umar in 636.

Belus — now called Nahr Namen, a small coastal river in Palestine, which flows past Akka and forms a sandbank on which the old Phoenicians successfully cultivated purple snails, the most expensive colouring matter of Antiquity. The quartz sand of the little river seems to be the best glass sand in the world. The name is derived from a legendary leader of the Assyrians.

Bilaur — Arab designation for rock-crystal as well as crystal glass.

Borneo — second-largest island in the world, a part of the East Indian, Australasian Archipelago.

Bosphor, Bosporus — the straits between the Black Sea and the Sea of Marmora. Constantinople lies on its south-western end.

Brabant — Belgian (Netherland) province.

Burgundy — French Bourgogne, an old French Dukedom, today represented roughly by the provinces of Ain, Saône, Loire, Côte d'Or, and Yonne, to be distinguished from the former Kingdom of Burgundy, also called Arelat (Arles) which lay farther to the south and which, soon after its foundation in the tenth century, became a part of France, whereas the Dukedom fell to France only after the death of Charles the Bold in 1477.

Byzantium — the old Greek name for Constantinople, since 1453 the capital of Turkey (till 1919).

Cadiz — formerly written Cadix, a famous old port in the S. W. of the Iberian peninsula; belonged to the Phoenicians, then the Romans, later the Arabs and now to Spain. After the discovery of America was for a long time the most important European harbour.

Caliph (Chalifa) — means "representative"; the title of Muslim rulers, later used by Turkish emperors (sultans).

Campagna — a region in S. Italy (W. Coast). Main town: Naples. For its beauty and fertility the Romans named it "regio felix" — the happy region.

Carthage — Quart Chadash, New Town, Greek: Karchedon. A large city, later a powerful N. African state not far from Tunis today; founded in 850 B. C. by Phoenician seafarers from Tyre and Sidon; the last power to oppose the Romans in the West.

Cassius, Dr. Andreas — a Hamburg doctor who observed in 1666 that red dust coagulated on a zinc plate when dipped into a solution of gold; following the famous chemist Glauber he discovered his gold purple. Viz: The Life of Kunckel.

Celts — The western-most Indo-Europeans, today limited to France, Ireland, Scotland and Wales; formerly inhabited the whole of France, Belgium, the Netherlands, Switzerland, N. Italy, Austria, Bohemia, also Spain and a part of the Balkans.

Charles II, the Bald — son of Ludwig I, the Pious, born in 823 in Frankfurt on Main, died 877.

Charles V, the Wise — French king, born 1337, son of John I and Judith, daughter of John of Luxemburg and Bohemia, reigned 1364—80.

Charles the Bold — 1467—77, Duke of Burgundy, son of Philipp.

Charlesmagne — King of the Franks, first Holy Roman Emperor, (768—814); birthplace unknown; fought against the Saxons, Bavarians, Avares, Danes, Langobards and the Spanish Moors. Consolidated the Empire; had friendly relations with the Caliph of Bagdad, Harun-ar-Rashid; caused a mighty cultural development.

Chartres — town in W. France on whose most elevated point the famous cathedral was erected. The building of the cathedral was started in 1020; it has five naves. After a fire the cathedral construction was concluded in 1260. Chartres, in Roman times Autricum, was one of the oldest settlements in Gaul.

Chaton — the metal part of a gold or silver decoration into which precious stones were set.

Childebert — the name of three Frankish kings: I, son of Chlodwig I, 511—558; II, 575—596; III, 674—691.

Chlothar II — 548—628, son of Chilperich I and Friedegund, King of the Franks; came of Burgundian nobility, treacherously captured Brunhilde and tortured her to death so that in 622 he unified the entire Frankish Empire under his sceptre.

Cinquecento — Italian "five hundred"; designation for the art of the 16th century in Italy.

Cloisonné — honeycomb glass.

Codex Theodosianus — the book of laws of the East Roman Emperor Theodosius, which appeared in 438 A. D.; in it the Byzantine glass-makers were freed from all taxes and granted valuable privileges.

Constantine VII — Porphyrogenetos, Emperor of Byzantium, 905—59. Only son of Leos VI, ascended the throne at the age of seven. A scientist who spent the entire 47 years of his reign over books, and damaged his empire by leaving the ruling in the hands of his courtiers.

Constantine the Great — Flavius Valerius, one of the greatest of Roman rulers, born in today's Serbian Nish in 280 A. D. His father was an officer. He gained his greatest support from the Christians and changed the seat of Empire to Byzantium which was re-named in his honour.

Copts — Christian descendants of the old Egyptians. The Evangelist St. Mark is considered the founder of the (independent) Copt-Christian Church.

Cord — Old measure of wood, about 128 cubic ft.

Cosmas — Cosimo de Medici 1389—1464, ruler of Florence who won an enormous fortune through successful trading. His son was Lorenzo Magnifico.

Cufic — from Cufa, a famous S. Babylonian town which was founded by the Arabs in 637 and destroyed by the Mongols in 1010. Cufa was the cultural centre of the Neo-Islamic movement.

Cuneiform writing — originally a form of picture writing, later developed into a system of syllables and sounds; the writing of the old Sumerians and Assyrians; it is called "wedge-writing" because symbols were imprinted on soft clay with a triangular-shaped wooden stick, making wedge-shaped imprints. These tablets were then baked.

Cyprus — a large island in the E. Mediterranean Sea, where copper was once mined.

Cyril and Methodius — Slavonic Apostles, sons of an Imperial Byzantine leader in Salonica, i. e. Greeks. Born in the twenties of the eleventh century, they came to Moravia and taught Christianity according to the Greek-Orthodox rites. That brought them into conflict with the German-Latin Church lords.

Damascus — one of the oldest towns of the Orient. Mentioned already in the Bible and in a Carnacian record from the 16th century B. C. The most important and largest town of Syria.

Diatreton Vase. — In essence Diatreton vases are double-walled vessels. The inner section — the basic part — is approximately bell-shaped. Of the outer vessel only certain portions remain which form a net, a letter or possibly a figure decoration. The rest of the outer vessel is connected with the inner one by thin, fired-on pegs about 8 mm in height and 2 mm in diameter.

It can be imagined that various theories about their production have been put forward. It was assumed, for instance, that the Diatreton Vase was created out of a thick-walled one-coloured, or cased vessel by the use of chisel or cutting wheel until only the thin pegs remained. Such production, however, would be possible only with skill, which would approach the miraculous, or by the application of perfect tools which can hardly have existed in the third to fourth century A. D.

A different way was suggested by W. v. Eiff who attempted to produce the Diatreton Vase by superimposing rings of varying width and by encasing the vessel in a coat of glass, without, however, reaching practical results.

In a remarkable study "The Roman Diatreton Vases in the Eyes of a Technician of Hollow Glass" (Glass-Technical Reports of the German Glass-Technical Association, Frankfurt on Main, Year 25, vol. 2, February 1954) Karl Wiedmann, Geislingen, is of the opinion that a certain "trick" must lie at the basis of the production of Diatreton, even in full appreciation of the achievements of the Ancients. The thickening of the top edge, the bell-shaped form of the vessel, the shapes of the pegs and their character, the lower section of the inner vessel, always lacking a bottom, the coloured glass in the inner vessel, but the crystal-clear upper layer — those were the typical characteristics of the Diatreton Vase.

At the same time glass vessels with glass drops were being produced, most of which were blown without moulds. To this day we know vessels with a round bottom which can stand only in straw baskets (liqueurs from Italy).

The glass-maker of the time made the straight bottom by melting on a piece of glass, even coloured. Better results were achieved by pressing a piece of wood into the glowing bottom, whereupon it was pressed inwards. (Compare also our oldest, thin-walled, silver-inlaid vessels, such as candlesticks, ashtrays etc.)

Wiedmann drew the relevant conclusions from these facts and successfully tried to produce Diatreton. The blown vessel was squeezed with a wooden implement under constant turning of the blowpipe until a double-walled vessel was created. When worked by hand, the distance between the two walls was not always even. Now the problem was to " place" the pegs. A piece of viscous glass, melted onto the outside of the vessel formed a drop. Into this a glass peg was pressed while it still glowed until the glass of the drop melted to the outer wall of the inner vessel. The pegs were then removed or sometimes left there. Coloured pegs were made of coloured glass. The distribution of the pegs depended on the decorations of the outer vessel. The work demanded great skill on the part of the craftsman. The glass had to be kept at a high temperature so that all pegs kept firm and, chiefly, so that all the drops could be pressed through. K. Wiedmann is of the opinion that this complicated job was probably carried out by stone-cutters and glass-engravers who at that time already possessed remarkable skill and excellent technical means. To increase the firmness of the outer layer the cavity between the two walls was filled with wax, for example. The production was patented (D. R. P. 674546, Kl. 32 a v. 30. 9. 1939) and such articles have since been produced.

Dsher — the third ruler of the first dynasty of old Egypt.

Eifel — N. W. range of hills of the Rhine Mountains, running in the direction of Luxemburg and Belgium.

Ell — a length measure. Had different length in different places, e. g. in Prague 1 ell = 24 inches (59.389 cm); in Vienna 1 ell = 77.7 cm.

Etruria — later Toscany, Greek: Tyrrhenia, a region in Central Italy; a powerful state before the advent of the Romans.

Euphrates and Tigris — the two main rivers of Mesopotamia, today in Iraq.

Falknov — a small town in N. Bohemia. To be distinguished from the brown-coal town by the same name, now called Sokolov lying on the R. Eger in W. Bohemia.

Fatimids — an Arab dynasty founded in 909 by Obeid-Allah, who claimed to be the true descendant of Ali, and the daughter of Mohammed, Fatima. Their empire embraced the area of today's Algeria, Tunis, Tripoly, for a time also Morocco. In 969 they conquered Egypt and changed their seat of government to Cairo. The empire of the Fatimids flourished and grew until 1171, when Al-Ahdid was deprived of his throne by Saladdin.

Faïence — porous earthenware goods, covered with transparent or opaque glaze, often with coloured decorations on or under the glaze.

Ferdinand I — King of Bohemia and Hungary, Emperor of Germany, 1503—64.

Ferdinand of Tyrol — his second-born son.

Fes — also Fas, Fez, until recently the capital of Morocco, founded by the famous Sultan Idris II, built so strongly that until the French occupation it had never been overpowered.

Filo (Philo) — of Alexandria, born about 30 B. C., of a distinguished Jewish family; extraordinarily learned. Witnessed the coming to power of Emperor Claudius. Left many writings.

Fischer — brothers from Turnov, in Bohemia, who in Venice discovered the secret of composition glass and introduced this with great success in Turnov in 1711. That was the beginning of the Jablonec artificial stone industry.

Flavius Josephus — the author of "The Jewish War", born in Jerusalem in 34 A. D., witnessed the fall of the capital, stood in the service of Rome.

Fondi d'Oro — the name of a method of glass-making during which liquid glass was applied in layers to gold folio, that had been laid on glass, until the folio was encased in between the glass. This was achieved already in Old Rome, chiefly during the early Christian period. A later form are the double-walled glasses produced in Bohemian glass-houses during the 18th century.

Franks — ("Freemen") Germanic tribes in the region of the middle and lower Rhine who united in their common fight against Rome, later made a joint attack on Gaul to which they gave its new name. Their empire at times extended over today's France, Belgium, Holland, N. Italy, Germany (West of the R. Elbe). The greatest king of the Franks was Charlesmagne (died 814) the first Holy Roman Emperor in W. Europe.

Gabes — township and harbour in S. Tunesia, lying on a narrow tongue of land in the Bay of Syrtis, between the sea and a group of salt lakes which Herodot called the Tritonic Lakes.

Galkishar — King of Assyria, reigned in the 17th century B. C.

Gaul — Roman name for France (and Belgium).

Gallienus Publius Licinius — Roman Emperor, reigned from 260—268; son of Valerian.

Grand Elector — elector of the Holy Roman Emperor (of Germany). There were 7 : Three Archbishops (of Cologne, Mainz, Trier) and the Kings of Bohemia, the Palatinate (became part of Bavaria in 1621), Saxony and the emperor of the Franks (succumbed to Brandenburg later).

Green vault — called after the green (Prophet's) flag of the Turks of which they were deprived at Vienna by the King of the Poles Jan Sobieski in 1683; through the ruler of Poland and Saxony this flag then came to Dresden, giving its name to the treasury in Dresden with its magnificent works of art.

Groschen — a medieval coin of French origin which was used in Bohemia for many centuries. It was counted in sixty pieces (one "kopa"). Its value varied with the ages, in the middle of the sixteenth century, for example, thirty made one (Joachims) thaler.

Guilds — a privileged body of craftsmen. As long as the craftsmen worked as serfs at the different courts there were no guilds. When the individual's work was no longer a mere duty but also a right, workers in the same crafts joined in brotherhoods, out of which the guilds developed. With the growth of towns guilds spread all over Europe.

Hadrianus Publius Aelius, Roman Emperor from 117—138 A. D.

Hamonitrum — Roman name for the "frit" raw glass.

Harun-ar-Rashid — Caliph of Bagdad, 786—809, patron of Arts and Sciences, said to have been a friend of the poor and subjected, but in fact a cruel ruler. Had many of his enemies murdered, except for Idris who succeeded in escaping to Morocco where he was murdered two years later by hired murderers.

Heat — the period during which a fire was kept up continuously under a glass furnace. It lasted short of a year and the work contracts of glass-house employees were made out for this span of time. Between two "heats" the furnace was rebuilt.

Hebron — now Kirjat-Arba, a very ancient town in S. Palestine, 31 km from Jerusalem.

Hedshra — the emigration, departure. This word applied to the flight of Mohammed from Mecca to Medina on June 20th, 622 A. D. The extensive Arabic world counts its new calendar from this day.

Hedwig — Saint, Countess of Silesia (1174—1243), daughter of Berthold IV, married at the age of 12 years to the Silesian Duke Henry I; Patron-Saint of Silesia.

Henry II — King of France, born 1518, died 1559, son of Franz I and Claudia, daughter of Louis XII, hated Charles V and his son Philipp II, against whom he led continual wars.

Henry III — King of France, born 1551, died 1589, son of Catherine of Medici, persecuted the Protestant Huguenots and was partially responsible for the notorious "St. Bartholomew's Night".

Herculaneum — old Italian town in Campagna, near Naples, was destroyed at the same time as Pompej by the eruption of Vesuvius in 79 A. D.

Herms — square stone columns, widening towards the top, with busts of the god of trade (Roman Mercury): Hermes.

Herodot — Father of History, Greek historical writer, born 484, died 425 B. C.

Hispania — Old Roman name for Iberia, Spain.

Horus — Egyptian god which Herodot compared with the Greek sungod Apollo.

Hyksos — Semite occupants of old Egypt.

Ibn Chaldun — Abus Seid Abdurrachman, great Muslim historian of Berber origin from Tunis, 1332—1406. His History of African Man is a keywork to the knowledge of the tribal order and the economic life, even if distorted from an orthodox Arab point of view.

Idrisi — Arab geographer, born in Ceuta, now Spanish Morocco, 1100, died 1185; came from the ruling family of the descendants of the Prophet. His key work, called "Rogerbook" by the Arabs, seems to be the best book on medieval geography.

John I, the Kind-Hearted — King of France, 1350—64; son of Philipp IV.

Justinian — Emperor of Byzantium, born 483, died 565. His general Belisar destroyed the empire of the Vandals in Africa and the kingdom of the East Goths in Italy and led three wars against Khosro, King of Persia. Justinian had the St. Sophy Cathedral in Constantinople built.

Kaaba — a dice; the most important sanctuary of the Mohammedans in Mecca. Each Muslim must turn in the direction of this mosque five times a day, at prayer times. In the Mosque there lies a black stone "from heaven" (a meteor).

Kaffe — Theodosia, now Fjodosia, a harbour in the Crimea, USSR.

Khosro (Chosru) — Nushirwan, i. e. Immortal Soul, called the Great, son of Kobad, a famous New-Persian, pre-Islamic king of the Sassan family; 531—579; contemporary of the East-Roman Emperor Justinian; the exemplary ruler, often compared with King Solomon or with Alexander the Great.

Koran — "a Book", the sacred writings of the Mohammedans, consisting of 114 chapters (Surahs) with 6616 verses (Ajats) of rhymed prose. The believers are convinced that the book was written by angels and that the arch-angel Gabriel dictated it word for word to the Prophet.

Lapis Lazuli — a mineral which on account of its blue colour was also called sapphire in Antiquity. Today mainly found in Chile and Central Asia.

Leopold I — Roman Emperor, King of Bohemia, second son of Ferdinand III; reigned from 1658—1705.

Lorenzo Medici — 1449—1492, ruler of Florence, great patron of the Arts.

Lybians — Hamite ancestors of the Egyptians, Numides, Berbers and the ancient Moors, the original inhabitants of N. Africa.

Lykurgos — originally a Greek-Doric god, said to have been the founder of the state of Sparta.

Mamelukes — "slaves", originally a military body of 12 000 slaves which the Egyptian Sultan Nedshmus bought from the Dshingis-Khan, and among whom he divided almost the entire soil of the country. The Mamelukes soon reached such a privileged position that they established their own dynasty.

Marco Polo — the famous world traveller of the Middle Ages, who discovered the Far East; born in Venice in 1254, died 1324.

Margarete of Austria — Daughter of Maximilian I and Marie of Burgundy; born 1480, died 1530.

Maria Theresa — Daughter of Charles VI, the last Habsburg; born 1717, succeeded him to the throne, had to suffer the loss of almost the whole of Silesia to Frederick II.

Maximilian II — Roman Emperor, King of Bohemia, son of Ferdinand I and Anna Jagello of Bohemia and Hungary; born 1517; reigned from 1564—76.

Melquart — God of the Phoenician town of Tyre (Melq — King, Qart — Town).

Mendeleyev, Dimitri Ivanovich — famous Russian chemist.

Meni — also Narmer, King of Upper Egypt, conquered Lower Egypt and is considered the founder of the Kingdom and the First dynasty. Lived about 3 400 B. C. Founder of the town of Memphis.

Merovingian — 481—752, Frankish ruling family.

Mesopotamia — "between the two rivers" the land between the lower reaches of the twin rivers Euphrates and Tigris.

Michael Fjodorovich — the first Russian Czar of the Romanov family; born 1596, died 1645.

Mithridates — Names of the Pontic kings of Antiquity (Asia Minor) who, falsely, claimed their descent from the Persian kings Cyrus and Darius. The most famous was Mithridates VI, called Eupator, born 132, died 63 B. C.

Monza — town in Italy, 17 km from Milan; seat of the Langobard kings. Here Queen Theodelinde laid the foundation stone to the cathedral of St. John in 595. The treasure of the Langobards, together with the "iron crown" lay here.

Mycenaean culture — 1400—1200 B. C. like the Cretian pre-Greek culture still not closely studied.

Nara — Town in N. E. Japan, formerly seat of the Emperors since the time when Dshimmu, the first Micado, who came from heaven, unified the Empire in 700 B. C.

Nero — Claudius Drusus Germanicus, Roman Emperor, 54—68, famous for the fights of the gladiators and the persecution of the Christians.

Nimrod — a hero of the Old Babylonian legends, alleged to have been a passionate hunter, the founder of Ninive; A castle still bears his name today (Borsippe).

Ninive — capital of Assyria.

Normandy — province in N. W. France, belonged to England for some centuries; strongly mixed Germanic settlers (Normans).

Ostensorium — a shrine for reliquies.

Pallas Athene — Daughter of Zeus, Greek goddess, protectoress of Athens (in Rome called Minerva). Is said to have come to life in full armour from the head of her father.

Parans Vitra — medieval designation for glass-makers.

Petrie Flinders — Sir William Matthew, English archeologist and Egyptologist, born in 1853, excavated the pyramids, took part in excavations in Fayum, Tanid and finally of the ruins of El-Amarna and Koptos. Lectured at University College, London. Author of numerous books.

Petronius — Satirical and novel writer at the time of Nero.

Phoenicians (from Phoinik — date palm) — a Semite people who settled in the middle of the third century B. C. along the coast between the Lebanon and the sea. The lack of land drove them out to sea. They became the most famous merchants and discoverers of Antiquity. Their most famous colony was Carthage, later the capital of the state.

Pliny the Elder — Roman poly-historian, born 23 A. D., died together with his nephew, Pliny the Younger, the naturalist, during the eruption of Vesuvius in 79 A. D. Was officer in Germany, later lawyer in Spain, S. France and Africa.

Plutarch — Greek historian and moralist, born 50 A. D., died 120.

Pompej — name of different old Roman statesmen. Here it is Cn. P. Magnus, a member of Caesar's triumvirate, the conqueror of Egypt.

Porphyry — a granit - like stone of special structure.

Portland — Island off the S. coast of England, seat of a family of English high aristocracy. The Portland Vase was found in a tomb near Rome in the 16th century, belonged first to a family Barberini, then became the property of Lord Hamilton and from him it passed to the Duke of Portland. It is now in the British Museum.

Potash — potassium carbonate.

Procopius — Greek historian at the time of Justinian, born in Palestinian Caesarea, was secretary and jurist of general Belisar and wrote a number of important books on history.

Ptolemies — of Macedonian origin, the last Egyptian dynasty. Their founder was a general under Alexander the Great. The last ruler was Cleopatra.

Ptolemy II — Philadelphos, 285—247 B. C. raised Egypt to its former cultural level.

Rabanus Maurus — German theologist, 776—856, Archbishop of Mainz.

Reginhardt — Abbot of the central Bohemian, formerly Church-Slavonic Monastery at Sázava; alleged to have been a Rhinelander; the first glass expert in Bohemia.

Renaissance — a spiritual and artistic movement in Europe which replaced the medieval way of thinking by the re-birth of Antiquity (hence its name).

Rhenish gulden — also florin, a coin of certain value in Central Europe after the Middle Ages..

Roland — historical personality, medieval hero, leader of the rear-guard of the Spanish army of Charlesmagne; attacked by the Arabs in the Pyrenees he held out until the main force was saved. He found his death during that action.

Rudolf II — Roman Emperor, King of Bohemia, born 1552, died in Prague in 1612; oldest son of Maximilian II. Great friend of the Arts and artists, supporter and patron of the Sciences. Gathered a collection of world fame in Prague Castle.

Saccara — Egyptian village, 6 km from Cairo, on the edge of the desert. There are 11 pyramids in its area.

Salonica — Thessalonika, a Greek harbour, established since 315. A Christian community already at the time of Paul. After 904 belonging to the Saracens, then Turks, remaining, however, a Bulgarian cultural centre; the latter still lay claim to it.

Santa Maria Del Fiore — the main church of Florence.

Sargon II — the greatest and most powerful King of Assyria; 722—705 B. C.; soon after ascension to the throne equipped his army with iron swords, beat the Israelites, whom he resettled, founded the last, but most glorious dynasty.

Sapor — name of several Sassan kings in New-Persia.

Schwanhardt — Georg, stone cutter in Nuremberg, 1601—67, studied under Kaspar Lehmann in Prague, and inherited his royal concession for glass cutting, returned to Nuremberg in 1623, taught Emperor Ferdinand II diamond engraving from 1652—53. His son and three daughters continued his craft after his death.

Seleukeia — Name of several Greek settlements in Asia Minor in the post-Alexandrian period, founded by the Syrian generals of Alexander, the descendants of Seleukos.

Senecca — Aeneus Lucius, Roman Rhetor 54 B. C. — 40 A. D.

Sesostris — a legendary pharaoh, to whom all the works of the 18th and 19th dynasty are ascribed; is said to have ordered a glass column to be made in 1643 B. C.

Seven Years' War — 1756—63. Maria Theresa tried to re-gain Silesia with the help of France and Russia.

Sèvres — capital of the French department of Seine-et-Oise, seat of the great state porcelain factory (founded in 1745). It was the property of Louis XV and constituted a dangerous rival to Meissen.

Sidon — old Phoenician harbour, today Saida in Syria.

Silesian Wars. — 1740—42 and 1744—1745, fights between Austria and Prussia for Silesia.

Škrěta Karel — of Zavořice, famous Czech painter. 1610—74.

Sophy St. (Aja Sofia) — the temple of Wisdom, one of the wonders of the world, built by Emperor Justinian I, in Constantinople, the greatest sanctuary of the Eastern Church, since 1453 a Mosque.

Sulla — Lucius Cornelius Felix, 137—78 B. C. Roman general, beat the Numid king Jugurtha.

Syria — Suria, Soristan, Bar-esch-Scham "the land on the left" coastal area in West Asia, the eastern border of the Mediterranean Sea, with the cities of Beyruth, Damascus and Aleppo.

Talent — an Attic coin, representing cca 26 kg precious metals.

Tell Asmar — place where old Assyrian glass was discovered in Mesopotamia from the time 2 700—2 500 B. C.

Tell-el-Amarna — site of excavations in Egypt, see Amenhotep IV.

Thaler (Joachimsthaler) — an old Bohemian silver coin of Count Schlick, 1519, changed in value, finally worth 1½ gulden or 3 crowns (before 1914 = 3 marks). Apart from the gold ducat the most favourite coin of E. Africa and W. Asia.

Thebes — the town of a hundred towers, once the metropolis of Upper Egypt, residence of the most famous pharaohs.

Theodelinde — daughter of the Bavarian count Geribald, wife of the Langobard king Anthari, later wife of Agilulf of Turin whom she raised to the throne, died in 628.

Theodosius I — the Great, Roman Emperor, originally general of Valentinian and Grazianus, great statesman, the last ruler of the still undivided Roman Empire, died in 395 in Milan.

Theophilus — Roger, monk, later provost of the Helmershausen Monastery near Paderborn in Westphalia; author of the excellent historical-technical work Schedula diversarum artium, lived about 1100.

Thutmosis III — Egyptian pharaoh, 1479—47 B. C. fought 17 wars, extended the Empire as far as the Euphrates, occupied Cyprus and the Aegean archipelago.

Thutmosis IV — reigned from 1413—1405 B. C., began the conquest of Asia Minor.

Toscany — in Antiquity the kingdom of the Etruscans, region in C. Italy. (Capital Florence.)

Trabant — a runner, guard, companion. In the Middle Ages the most important member of the body guard.

Trier — originally Augusta Trevirorum, old Roman settlement in W. Germany, once the seat of archbishops and Grand Electors, for a long time the residence of the Roman Emperors.

Tshapoli — Ciapogli, Chinese cracked glass.

Tyre (Sor) — the most important town of the Phoenicians with the famous temple, industry and rich art treasures.

Umayyads — an Arab ruling dynasty with Damascus as their seat (661—750).

Usertesen I (Senvosret) 1975—1930, B. C. Egyptian king, who moved the S. frontier above the second cataract, had copper and turquoise mined on the Sinai peninsula, built temples.

Utica — ancient harbour near Carthage, now Tunesia.

Venice — provincial capital in N. E. Italy, belonged to Austria until 1866; before 1797 an independent merchant republic with large oversea properties, built on a group of islands in the middle of shallow lagoons and was therefore insuperable from the land. It was founded as a place of refuge during the attacks of the barbarians at the time of the tribal migrations and played an important role in politics, culture and trade during the Middle Ages.

Wadi-el-Natrun — a group of lakes in Lower Egypt roughly 70 km to the West of the Nile delta, near the Lybian desert; from here since ages immemorial white soda was brought.

William the Conqueror — Norman, English king, born in Falaise in 1027, died 1087.

LIST OF COLOURED REPRODUCTIONS

I. Egyptian Balsam Containers Made of Opaque, Multi-coloured Thread-Glass; the Various Patterns Were Gained by Combing the Mass of Glass.
II. Two Famous Old Egyptian Vases: the Vase Belonging to Pharaoh Thutmosis III (1515—1461 B. C.) and a Balsam Container Made of Crystal-Glass, with the Name of Amenret.
III. Egyptian and Phoenician Vessels Made of Opaque, Multi-coloured Thread-Glass. The Various Patterns Were Gained by Colouring the Mass of Glass.
IV. Alexandrian Glass Vessels from the Time of the Roman Rule over Egypt.
V. Egyptian and Roman Mosaic Glass (Ancient Millefiori).
VI. Ancient Vessels with Fired Decorations in Various Shapes.
VII. Ancient Amphora with Fired Decorations.
VIII. Four Coloured Roman Beakers with Fired Decorations.
IX. Transparent Vessels, Decorated while in Viscous Stage with Coloured Glass-Threads, in the Form of Snakes.
X. Roman Gladiator Vases in Bas-Relief.
XI. Various Coloured Latin Glasses: Cameos, Vasa Murrina, Layer- and Cut-Glass.
XII. Small, Violet Plate of Roman Origin with Milk-Glass Threads and Alexandrian Beads, Made of Millefiori Glass.
XIII. "The Pompej Vase", Made of Plastically Cut "Layer Glass".
XIV. Section of the Decorations on the Famous "Pompej Vase".
XV. Section of the Decorations on the Famous "Portland Vase".
XVI. Blue Glass Beaker from the Fourth Century, Found Near Amiens in France.
XVII. "Trunk Beaker" in Two Colours, 7th — 8th Century.
XVIII. Small, Oriental Flask of White Glass, Coloured with Enamel and Gilded.
XIX. Arab Lamp with Cuneiform Inscription, Enamel and Gold Decorations.
XX. Persian Pot Made of Cobalt Glass, Richly Gilded.
XXI. Oriental Beaker, Enamel and Gilt Painted.
XXII. Persian and Venetian Glass, Enamel Painted and Gilded.
XXIII. Painted Stained Glass. Section from the "Ascension". Mary with the Apostles. (Middle of the 12th Century, Le Mans Cathedral in France.)
XXIV. Painted Stained Glass. Section from "The Death of Mary"; Below a Shoe-Maker at Work. (Beginning of the 12th Century. Cathedral at Chartres in France.)
XXV. Green, Enamel-Coloured, Venetian Beaker.
XXVI. Painted and Gilded Venetian Glass.
XXVII. Venetian Milk-Glass with Relief Decorations. A Painted Venetian Beaker of Milk Glass.
XXVIII. Venetian Millefiori, Set with Bronze.
XXIX. French, Enamel-Painted and Gilded Beaker.
XXX. German Mug with the Double Eagle, the Coats-of-Arms of the "Lands" and Christ on the Crucifix; About 1649.
XXXI. Ancient Vase of Rock-Crystal Set with Gold and Precious Stones. (Placed in the Treasury at St. Denis by Abbot Sugur, a Minister of Louis VI and VII; i. e. in the 11th Century.)
XXXII. Bohemian, Coloured, Double-Walled Glasses. Middle of the 18th Century.

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I., III., VI., VII., XI., XVII. — W. Froehner: La verrerie antique (Collection Charvet, Dijon 1879).

II., IV., VIII., X., XII. — XVI. — Achille Deville: Histoire de l'Art de la verrerie dans l'antiquité, Paris 1871.

V., XIX., XX., XXVI.—XXX. — Felix Slade: Catalogue of the Collection of Glass, London 1871.

IX., XII. — Anton Kisa: Die antiken Gläser der Frau Maria von Rath, Bonn 1899.

XVIII., XXV., XXXI. — Jules Labarte: Histoire des arts industriels au Moyen âge et à l'époque de la Renaissance, Paris 1864, 1875.

XXXI. — G. Schmoranz: Altorientalische Glasgefäße, Vienna 1898.

XXXII. — G. E. Pazaurek: Die Gläsersammlung des nordböhmischen Gewerbemuseums in Reichenberg, Leipzig 1902.

ILLUSTRATIONS TO TEXT

1. Roman "fondi d'oro", depicting a ship builder and shipyard workers. Cut out of gold folio at the bottom of a cup. Reproduced from A. Kisa, vol. III. Title page 5
2. Cut and engraved jug of crystal glass; 17th century, Bohemia. Reproduced from Gerspach's work . . 7
3. Old Egyptian smiths working at the fire. — Relief on a tomb at Beni Hassan. Reproduced from Déville's work 13
4. Egyptian glass amphora from the time of the 18th dynasty. Reproduced from A. Kisa's work, vol. I. . . . 14
5. Glass vase, property of Pharaoh Thutmosis III. Reproduced from A. Kisa's work, vol. I. 15
6. Relief of old Egyptian smiths on a tomb from the time of Pharaoh Usertesen I. Relief on a tomb at Beni Hassan. Reproduced from Déville's work 16
7. Placing of the frit pots in an old Egyptian glass furnace at Tell-el-Amarna 17
8. Old Egyptian glass balsamarium. 18th dynasty, about 1500 B. C. Reproduced from A. Kisa's work, vol. I. 18
9. Vase belonging to Pharaoh Thutmosis IV, from Thebes. Reproduced from the works of A. Kisa. vol. I. 19
10. Balsamarium in the shape of a column. Reproduced from A. Kisa's work, vol. I. 20
11. Small vessel from the tomb of Amenophis II, from Thebes. Reproduced from A. Kisa's work, vol. I. . . 21
12. Beakers of Princess Nsichons; Egypt; time: 18th dynasty. Reproduced from A. Kisa's work, vol. I. . . . 22
13. Shapes of hollow glass vessels, excavated at Punic Utica. Reproduced from E. de Sainte-Marie 23
14. Phoenician bottle from Sidon, blown into a relief cast of the head of Medusa. Reproduced from A. Kisa 24
15. Phoenician oinochoe of opaque yellow-green combed glass. Reproduced from F. Slade 25
16. Phoenician oinochoe; colours: lapis lazuli and yellow, of combed glass. Reproduced from F. Slade . . . 25
17. Mycenaean frieze of glass paste on an alabaster ground. Reproduced from K. Schuchhardt's work: "Schliemann's Ausgrabungen" 26
18. Old Jewish glass in the shape of a medallion. Reproduced from Gerspach 27
19. Old Jewish bottle, blown into relief cast. Reproduced from Gerspach 28
20. Small Phoenician toilet amphora of transparent blue, combed glass. Reproduced from F. Slade 29
21. Coloured Roman cup, carried out in "murrina" technique. Reproduced from A. Kisa, vol. II. 31
22. Small Roman vessel, blown into a cast of a Negro head. Reproduced from W. Froehner 32
23. Roman bottle blown into a cast representing grapes. Reproduced from W. Froehner 33
24. Roman glass cup and two amphoras of coloured glass. Reproduced from F. Slade 34
25. Smooth old Roman glass cup. Reproduced from W. Froehner 35
26. Old Roman glass: jug with fired glass threads decorated in geometrical patterns; square, coloured vessel with handles and a plain carafe. Reproduced from W. Froehner 36
27. Old Roman beaker, decorated in geometrical pattern with fired glass thread. Reproduced from W. Froehner 37
28. Slim Roman jug with diagonal fluting, of light green glass. Reproduced from F. Slade 38
29. Magnificent Roman bottle of crystal glass, blown into a relief cast of unusual shape. Reproduced from Felix Slade 39
30. Roman beaker with fired decorations of prolonged glass tears. Reproduced from A. Kisa, vol. I. 40
31. Roman glass beaker, with adhering sea animals. Reproduced from A. Kisa, vol. III. 40
32. "Animal fight" painted on a Roman bowl, excavated in Scandinavia. Reproduced from A. Kisa, vol. III. 41
33. Net glass, or Roman "Vas Diatretum" from Cologne. Reproduced from A. Kisa, vol. II. 41
34. Roman bottle of green glass decorated with snake-like coloured glass threads. Reproduced from F. Slade 42
35. Bottle with decorations from the Barbotin glass-house in the Rhine Valley. Reproduced from A. Kisa, vol. I. 43
36. Three Roman glass beakers with fired decorations of coloured glass. Reproduced from A. Kisa, vol. I. . . 44
37. Roman cut-glass cup with the relief head of Medusa embossed on the bottom. Reproduced from A. Kisa, vol. II. 45
38. Roman glass bowl with bas-relief, portraying a gladiator's fight in the circus. Reproduced from W. Froehner 46

39. Roman glass with magnificent cut relief of leaves. Reproduced from W. Froehner 46
40. The famous "Lycurgos Goblet". Reproduced from A. Kisa, vol. II. 47
41. Early Medieval furnace: To the left, a glass-maker is squatting, cleaning the broken frit. To the right, the master glass-maker is sitting, blowpipe in the furnace... Taken from the work by Rabanus Maurus (Bishop of Mainz; died 856): "Beati Rabani Mauri de universo libri XXII" lib. XVII. 51
42. Magnificent Byzantine dish, painted with enamel. Reproduced from Felix Slade 52
43. Scheme of the same Byzantine glass painting. Taken from Slade's work 53
44. Miniature from the 13th century: "The Meeting of the Hariri." Shows the shapes of glasses at the time. Taken from Gerspach 54
45. Arabian glass counters. Reproduced from Gerspach. 54
46. Syrian glass: First and third with embossed decorations from the fifth to seventh century A. D. The second a vessel with fired decorations. Based on C. J. Lamm, vol. II. 55
47. Bottle of combed thread glass from the 12th century. Syria. Based on the work of C. J. Lamm 55
48. Square Persian bottle, brightly decorated with enamel painting on a blue background. Reproduced from Felix Slade 56
49. Persian enamelled flagon. Reproduced from Felix Slade 57
50. Early Arabian lamp, probably from the tenth to eleventh century A. D., from the court of the Fatimes . . 58
51. Persian cut rock-crystal and glass counters from the sixth century A. D., taken from the following dish. Reproduced from Gerspach 58
52. Gold dish belonging to the Sassanid king Chosrua I; decorated with counters cut from rock-crystal and glass. Persia, 6th cent. A. D. Reproduced from Gerspach 58
53. Three enamelled and gilded drinking cups from the end of the 12th century A. D. The first originates from Palestine; the third is the world-famous "Charlesmagne Cup"; the centre: beaker set with silver 59
54. Three Syrio-Frankish drinking vessels, richly enamelled and gilded, from the 13th century. Reproduced from C. J. Lamm, vol. II. 60
55. Damascene drinking vessel from the end of the 13th cent. Reproduced from C. J. Lamm, vol. II. 61
56. Drinking vessel from Aleppo, 13th cent., decorated with enamelled and gilded figures. The two small bottles are of a similar time and origin. The fourth is "Luther's drinking cup" from Damascus, made between 1250—1310 A. D. Reproduced from C. J. Lamm, vol. II. 61
57. Luxurious enamel and gild decorated Islamic glass from the 14th cent. A. D. Note Chinese influence. Origin: Egypt and elsewhere. Reproduced from C. J. Lamm 62
58. Luxurious enamel and gild decorated Islamic glass from the 14th cent. A. D. Chinese influence. Reproduced from C. J. Lamm 63
59. Chinese vase of deeply coloured, cut glass with the symbol of "longevity". Reproduced from Gerspach . 64
60. Three Chinese "tobacco bottles" of "cased glass" with relief decorations cut in the ancient fashion. Reproduced from Gerspach 65
61. Antique Chinese enamelled and gilded glass jug, from the 13th—14th cent. Found in China. Reproduced from C. J. Lamm, vol. II. 66
62. Shapes of ancient, undecorated glass from the U. S. S. R. 1, 2, 4: Caucasian glass from the 7th—9th cent. 3: Bottle decorated with thread glass, Ukraine, 7th cent. Reproduced from C. J. Lamm, vol. II. 67
63. Old glass from the U. S. S. R.: Old greenish jug with fired decorations. Found in the Ukraine. Reproduced from C. J. Lamm, vol. II. 67
64. Old glass from the U. S. S. R.: 1. Caucasian jug from the 7th—9th cent. 2. Small jug of brown glass, decorated with irregular threads. Ukraine, 9th—13th cent. 3. Goblet of light-green glass, surrounded with glass threads. Poltava, Ukraine, 11th—13th cent. 4. Small Ukrainian jug of same period. Reproduced from C. J. Lamm 68
65. Old glass from the U. S. S. R.: Various shapes of Ukrainian folk vessels made between the 7th and 9th cent. Reproduced from C. J. Lamm 68
66. Old glass from the U. S. S. R.: Various shapes of old Ukrainian folk glass vessels made after 1000 A. D. Reproduced from C. J. Lamm 69

67. Old glass from the U. S. S. R.: Various shapes of old Ukrainian folk glass made after 1000 A. D. Reproduced from C. J. Lamm 70
68. Woodcut from the work by Jean de Montevillas "Road to Jerusalem" published in Basle, 1475, showing shapes of contemporary glass vessels 71
69. Frankish drinking vessel. Reproduced from F. Slade 73
70. The window in the church at Bonlieu serves as an example of the practical sense of the medieval glaziers. The double lines were formed, not with cames but with drawn lines. (Based on Viollet-le-Duc) 74
71. Painted window from the archway at the Cistercian Monastery at Heiligenkreuz near Vienna. About 1300. The ornaments are still entirely Romanesque. (Based on Camesina) 74
72. Example of two drawings of scale-like window patterns in which the bistre frame subdues the light in order to give the entire multi-coloured pattern a quiet, neutral character. (Based on Viollet-le-Duc) . . 76
73. "Charlesmagne and Roland" window in the French cathedral at Chartres, painted during the 13th cent. Engraving in Allgemeine Geschichte by W. Oncken, vol. II, 6./1. 78
74. Many scenes depicted on this famous window follow the fashion of the time in costumes as in habits of life during the 13th century; they do not give a true picture of life 79
75. The window in the church at Pontigny (13th century) is an example of the preference of Gothic and Romanesque art for interwoven patterns in wide, loose strokes with open loops. (Based on Viollet-le-Duc) 80
76. The window in the apse of the monastery church at St. Denis shows the maturity of French art at that period. (First half of 12th century). (Bucher) 82
77. An example of the details of the ornaments in the Nunnery at Klosterneuburg near Vienna. About 1300. Treated like a medallion window. (Based on Camesina) 83
78. Renaissance glass-painting from the 16th century by H. Holbein the Younger. Basle Museum. (Based on Woltmann) 84
79. Roman "fondi d'oro" plate, decorated with gold folio and enamel painting. Reproduced from F. Slade 85
80. Old French glass from Normandy. Reproduced from Gerspach 86
81. The historical development of the shapes of the so-called "Angster" and "Kuttrolf" glasses. Supplement to the work by Franz Rademacher. 1. 4th cent. Eastern Gaul. — 2. 15th cent. — 3. 15th cent. — 4. Beginning of the 16th cent. — 5. 17th cent. — 6. 5th to 6th cent. (Syria). — 7. 14th to 15th cent. — 8. 15th cent. 9. About 1500. — 10. 18th to 19th cent. — 11. 3rd to 4th cent. (Syria). — 12. 14th to 15th cent. — 13. 15th cent. — 14. Beginning 16th cent. — 15. 17th to 18th cent (Persia) 87
82. Celtic drinking vessels, based on Gerspach 89
83. Glasses from the Langobardian treasure of Queen Theodelinde at Monza near Milan, from the 6th cent. Reproduced from Gerspach 90
84. Cylindrical Bavarian drinking vessel from the year 1662, with a solemn procession, painted in enamel colours, held in honour of the christening of the son of the Elector. Reproduced from F. Slade 95
85. Venetian drinking vessel, painted with enamel and magnificently gilded, decorated with enamel beads. Reproduced from F. Slade 99
86. Venetian drinking vessel, painted with enamel colours. 15th cent. Reproduced from Felix Slade 100
87.—91. Five Venetian drinking vessels, with decorations in different coloured glass, milk glass and filigree. Reproduced from Felix Slade 101
92.—94. Two diamond stippled drinking vessels and a "tazza". Venice. Reproduced from Felix Slade . . . 102
95. Venetian wine glass on high stem with a chalice decorated with spun glass. Slade 103
96. Venetian wine glass on an eccentric, complicated stem. Slade 103
97. Venetian wine glass on high stem engraved with a diamond. Slade 103
98.—100. Venice: two cylindrical drinking vessels on different stems and differently decorated; in the centre a lid-covered vase of amber-coloured glass, magnificently worked. Reproduced from Felix Slade 104
101. Venetian bottle with fired decorations in filigree technique. Reproduced from F. Slade 105
102. An almost unbelievable shape of a Venetian filigree jug. Reproduced from Felix Slade 106

103. Venetian jar with a lid, of filigree glass. Reproduced from F. Slade 107
104. Method of work in the production of filigree threads and "millefiori" glass. Reproduced from Jules Labarte, vol. III, second edition 108
105. Patterns on the walls of the vessels, decorated with filigree threads, made in different techniques. Reproduced from Jules Labarte, vol. III, second edition. 109
106. Venetian flagon with complicated filigree decoration. Slade 110
107. Small Venetian jug with complicated filigree decoration. Slade 111
108. Jug cut from rock-crystal by Kaspar Lehmann, set with gilded silver and decorated with magnificent Czech garnets. Lehmann's work was drawn by J. Koula, its discoverer in the Vienna Museum. See chapter on Lehmann and his work 115
109. Hairpin studs of rock-crystal, found at Mycea. Reproduced from the work by Dr. K. Schuchhardt . . . 117
110. Magnificient Egyptian jug cut from rock-crystal in the 10th century A. D. Reproduced from C. J. Lamm, vol. II. 118
111. The counterpart to the previous bottle, cut from rock-crystal at the court of the Fatimes at the same time 118
112. Egyptian vase belonging to the Fatimes in the 10th cent. A. D. Cut from rock-crystal. Reproduced from C. J. Lamm, vol. II. 119
113. Two-handled Burgundian vase, cut from rock-crystal during the 15th cent. Height: 40 cm. Vienna Collection. Reproduced from C. J. Lamm, vol. II. 119
114. Two-handled medicine bottle, cut from red jasper, belonging to the Medici family (Florence, 15th cent). Reproduced from C. J. Lamm, vol. II. 120
115. Byzantine cup of cut rock-crystal from the 10th cent. set with silver. Reproduced from C. J. Lamm, vol. II. 120
116. South German cup, cut from rock-crystal, hemmed with enamelled gold, 16th cent. Reproduced from C. J. Lamm, vol. II. 120
117. The so-called "St. Hedwig's beakers", magnificent Egyptian cut glass from the 11th to 12th cent. A. D. Reproduced from C. J. Lamm, vol. II. 121
118. The so-called "St. Hedwig's beakers", magnificent Egyptian cut glass from the 11th to 12th cent. A. D. Reproduced from C. J. Lamm, vol. II. 121
119. The so-called "St. Hedwig's beakers", magnificent Egyptian cut glass from the 11th to 12th cent. A. D. Reproduced from C. J. Lamm, vol. II. 122
120. Shapes of wine glasses from the 16th century. Based on an old woodcut 123
121. Shapes of wine glasses from the 16th cent. Based on a contemporary woodcut 123
122. Shapes of medicine bottles from the 16th cent. Based on a contemporary woodcut 124
123. Albrecht Dürer: "Cudgel-shaped goblet" in the hand of Esculapus. Drawing from the years 1502—1504 . 126
124. Glass production in a glass-house in the year 1550. Georg Agricola: De re metallica libri XII, Basle, 1556 129
125 Hans Weiditz: "Stick goblet" and "Angsterkuttrolf" glass. Woodcut from the year 1521 130
126. J. Koula: The Kaspar Lehmann engravings on the famous goblet found at Castle Hluboká, carried out after the copper-engraving designed by Sadeler. From "Archeological Relics", XV, 1892 132
127. Alchemists' distillation bottles. Woodcuts from the work by Hieronymus of Brunswick: "Liber de arte distillandi de simplicibus". Published in Strassburg in 1500. — 1. Belly-shaped pot. 2. Urine pot. 3. "Helmet". 4. "Pelican" circulatorum and retort. 5. Two pots for the circulation of liquids. 6. Double "circulation" pots 135
128. Scheme of an engraver's table 136
129. Scheme of a polisher's grindstone. Reproduced from Czihak 136
130. Two magnificently engraved and cut drinking vessels and a goblet with a decorated lid. Bohemia, 17th cent. Reproduced from Gerspach 138
131. Smoothly polished and decorated barrel of crystal glass, which was formerly very popular. Reproduced from the work by Czihak 140
132. Wine-merchant with drinking vessels from the 18th cent. Copper-engraving by M. Engelbrecht and M. Rössler 145

133. Roving glass-seller from the 16th cent. Based on an old woodcut 151
134. Painting on a goblet of the hat-makers' guild in Cracow, 1664 153
135. View of a glass-house producing plate-glass. About 1800. Reproduced from by H. Schulz 159
136. Scheme of a German glass furnace 160
137. English glass furnace for "flint glass" 160
138. French glass furnace with indirect heating 161
139. Ground-plan of a French furnace for plate-glass. (The work at this furnace can be seen on the copper engravings in the supplement) 161
140. Bohemian grate furnace for heating with timber 162
141. Ceramics kiln with three floors 162
142. Venetian "tazza" with complicated filigree threads. Slade 171
143. Opened-out diamond cut drawing and inscription on a Dutch goblet from the 17th cent.: The Pope on horse-back and Christ on the ass as a beggar. From the year 1604. Museum of Antiquities at Amsterdam . 172
144. Magnificent glass drinking vessel with a diamond-engraved inscription demanding Dutch independence. 17th cent. Museum of Dutch Antiquities, Amsterdam 173
145. A Turnov Composition glass furnace reconstructed 181
146. Cross-section of a Siebert glass furnace 186
147. Side view of a Siebert glass furnace 187
148. Ground-plan of a Siebert glass furnace 187
149. Pot furnace, ground-plan 188
150. Pot furnace, side view 188
151.—152. Glass pots and lid 189
153. Old type of generator with a slanting grate 189
154.—155. Former pot furnace in an old glass-house: cross-section and ground-plan 190

LIST OF ILUSTRATIONS

The pictures marked PACM are exhibited in the Prague Arts and Crafts Museum.
The pictures marked ÚLUV belong to the archives of the Centre of Popular Art Production.

1. Work in a Glass-House (After a Copper-Engraving in Kunckel's Work, 1689) 1
2. The Glass-Maker Breaks up Raw Glass; in the Background the Stamp-Mill 1
3. Old Glass-Furnaces, Old Pots, Old Forms 1
4. The Inside of a Glass Furnace and the Outside with the Work-Holes 1
5. The Work of the Glass-Blowers Around the Glass Furnace, their Blowpipes and the Forms in Front of Them on the Floor 2
6. Implements and the Inside of an Old Glass Furnace 2
7. Furnaces for the Production of the Additional Raw Materials for Glass-Making 2
8. Making Glass Beads over Primitive Lamps; End of the 17th Century. (All Copper-Engravings 1—8 Come from Kunckel's Work; one Section is Taken from Agricola.) 2
9. A Flemish Miniature: Glass-Makers in a Glass-House in the 15th Century 3
10. In a Dutch Glass-House During the Second Half of the 17th Century. (Copper-Engraving from the Work by Abraham a Santa Clara.) 3
11. The Blown Glass-Cylinder Begins to Take Shape 4
12. Further Work on the Glass Cylinder 4
13. The Glass Cylinder is Rolled in the Production of Flat Glass 4
14. The Final Shaping of Glass Tablets in the Furnace 5
15. Mirror-Glass is Ground 5
16. The Final Polish of Mirror-Glass. (The 18th century process of producing mirror-glass by moulding and blowing. Copper-engravings from the contemporary work "Verrerie en glace ou manufacture des glaces".) 5
17. The Bohemian Glass-House in Breitenstein Shortly Before it Closed Down. (End of the 19th Century.) 6
18. Model of a Bohemian Glass Furnace, Roughly from the Year 1900. (Designed by Glass-House Master Franz Rückel.) 6
19. The "Living Quarters" of the Collective of Glass-Makers at Breitenstein. (End of the 19th Century.) 6
20. The "Kittel Glass-House" at Chřibská According to a Contemporary Painting from the End of the 18th Century. (It is assumed that on this spot stood once the historic glass-house that functioned at the very beginning of Bohemian glass-making of which records have been preserved. Today the so-called "Training Glass-House" occupies this spot) 7
21. The North Bohemian Glass Metropolis Nový Bor in the Year 1784 7
22. Merry-Making and a Roast on the Square in Nový Bor on February 20th, 1783 8
23. F. Egermann Accompanies Emperor Ferdinand I(V) on the Square in Nový Bor in the Year 1855 8
24. Karel Škréta: The Family of the Prague Cutter of Precious Stones, the Keeper of the Royal Treasury Dionisio Miseroni. In the Background There are the Enormous Whetting Stones. Oil Painting from the Year 1653. (Prague National Gallery) 9
25.—26. Two Sections of the Monumental Mosaic "The Last Judgement" over the South Portal of the St. Vitus' Cathedral in Prague. (Porta Aurea — Golden Portal.) This Mosaic was Made on Order of Emperor Charles IV. Venetian Work. Photo: State Photometric Institute, Prague. 10
27.—28. Two Sections from the Mosaic: "The Last Judgement" over the South Portal of the St. Vitus' Cathedral in Prague. No similar work of the kind has been preserved in Bohemia 11
29. Prof. Max Švabinský: Fragment from the Mosaic "The Baptism of Christ" in the St. Vitus'Cathedral in Prague. Executed by "Bohemian Mosaics", National Enterprise, in 1950. Photo: Glogar, Prague 12
30. Prof. Max Švabinský: Head of John the Baptist. Detail from "The Baptism of Christ". Photo: Zdeno Feyfar, Prague 12
31. Prof. Karel Svolinský at Work at a Mosaic Picture for the Ancient Horologe in Olomouc. Executed by "Bohemian Mosaics", National Enterprise. Photo: F. Vopat, Prague 13

32. Prof. Karel Svolinský: Detail from the Mosaic for the Horologe in Olomouc 13
33. Detail of a Painted Gothic Window in the St. Bartholomew Cathedral in Kolín on the Elbe, Bohemia, End of 14th Century. Photo: State Photometric Institute, Prague 14
34. "The Crucifixion of Christ" a Gothic Window Made of Stained and Painted Glass in the Catherine Chapel at Castle Karlstejn in Bohemia. Originated in the eighties of the 14th Century. Photo: State Photometric Institute, Prague 14
35.—36. Detail of a Painted, Gothic Window in the St. Bartholomew Church in Kolín, 1380. Photo: State Photometric Institute, Prague 15
37.—38.—39. Three Gothic Windows, Made of Stained and Painted Glass, in the Parish Church at Žebnice. Originated in the First Half of the 14th Century. The Reproductions belong to the Archives of the State Photometric Institute in Prague. The Windows are now in the National Museum in Prague 16
40.—41. Two Sections of the Window in the Parish Church at Žebnice 17

Six Famous Figures in the History of Glass:

42. Georg Agricola (contemporary copper-engraving) 18
43. Jacopo Versalini (contemporary copper-engraving) 18
44. Glass-House Master Elias Wander, According to an Oil Painting from the Year 1600. In the Glass Museum in Jablonec 18
45. Johann Kunckel (contemporary copper-engraving) 18
46. Dominicus Bíman, According to a Hodenius Drawing from the Year 1833 and Friedrich Egermann, According to a Lost Oil Painting 18
47. Decorative Beads, an old Egyptian Product from the pre-Roman Epoch. (Prague Arts and Crafts Museum-hereafter shortened to PACM.) 19
48. Old Egyptian Balsam Containers with Combed Threads of Opaque, Coloured Glass (PACM) 19
49. Fragments of the Ancient, Multi-Coloured Opaque Glass "Murrina". (PACM) 20
50. Ancient Glass Vessels of Roman Provenance (PACM) 20
51. Ancient Glass Vessels of Roman Provenance (PACM) 21
52. Ancient Glass Vessels of Roman Provenance (PACM) 21
53. Old Roman Glass of the Later Period. 4th Cent. A. D. The Goblet on the Left was Found in France. (PACM) 21
54. Ancient Glass Flask with a Handle. (PACM) 22
55. Old Roman Glass Urn with Two Handles, Container Missing. (PACM) 22
56. Gladiator in the Circus. Fragment of a Glass Engraving Found in the Rhineland 23
57. Gladiator in the Circus. Engraved Glass Cup Found at Cologne 23
58.—59. The Portland Vase. Cobalt Glass "Overlaid" with White Glass 24
60.—61. Samples of Celtic Glass in Bohemia and Moravia from the First Century A. D.:
    1. Millefiori Beads, found at Popovice near Rajhrad 25
    2. Fragments of Cobalt-Glass Bracelets, with Fired Decorations, Found at Stradonice in Central Bohemia 25
    3. Cobalt-Glass Bracelet, Decorated with a Waving, Yellow Line. Found at Pasohlávky in Moravia (no. 1, 3, in the Moravian Museum; no. 2, 4 in the National Museum in Prague). Glass Cup Found in the Grave of a Slav Nobleman near Kolín on the R. Elbe. End of the 9th or Beginning of the 10th Century. Moss-Green. (National Museum in Prague) 25
62. Frankish Beaker, 5th—8th Cent. 26
63. Frankish Goblets from the 6th Cent. Found at Nieder-Breisig (PACM) 26
64.—69. Byzantine Painted and Engraved Glass (C. J. Lamm) 27
70.—75. Byzantine Engraved Glass (C. J. Lamm) 28
76.—82. Eastern Glass Without Decorations, in the Museums at Kiev, Toledo, Vienna and Constantinople (C. J. Lamm) 29
83.—84. Oriental Glass from the 14th Century. Enamelled and Gilded; Chinese Influence 30
85. Magnificient Enamel and Gilt-Painted Flask, Influenced by Chinese Art. 14th Cent. 31

86. Mesopotamian Flask with Two Handles from the Second Half of the 13th Century. Decorated with Blue Enamel, Gilded, with Cuneiform Writing (Vienna) . . . 32
87. Early Medieval, Richly Gilded Flask with Coloured Enamelled Scenes from the Life of the Saracenes (Vienna) . . . 33
88. Gilded and Enamelled Lamp from a Mosque. Chinese Influence, 14th Cent. . . . 34
89. Magnificent Enamelled and Gilded Vase from Cairo . . . 35
90. Arab Lamp in the Cairo Museum . . . 36
91. Green Indian Glass from Putna, Bengal . . . 36
92. Chinese Tobacco Bottles of Cut "Cased"-Glass. 19th Cent. (PACM) . . . 37
93. Plastically Cut Dish of "Gold-Ruby", Probably Chinese (PACM) . . . 37
94.—95. "Forest-Glass" Beakers from the 14th Cent. . . . 38
96. Small Drinking Vessel, Decorated with Thread-Glass. Found at Birke in Sweden. 9th Cent. May be Russian, Possibly from Kiev . . . 38
97. Small Drinking Vessel, Decorated with Thread-Glass. Swabian, "Head"-Shaped. End of the 13th Cent. Light Green . . . 38
98. Three Drinking Vessels with "Stuck-On" Decorations, 15th Cent. . . . 38
99. —100. Two Tall, Light Green Drinking Vessels Surrounded with Thread-Glass. 16th Cent. . . . 39
101.—102. Bohemian "Wart" Glasses Found in a House in the Old Town of Prague. End of the 14th Cent. . . . 40
103. Bohemian Glass Beaker, Medieval Shape. Found at Sezimovo Ústí near Tábor, S. Bohemia. About 1400. (PACM) . . . 40
104.—105. "Optic" Glasses Decorated with Glass Threads, from the 13th Cent. . . . 40
106. Bull's-Eye Drinking Vessel. Photo Brok, Prague . . . 41
107.—108. Stick-Like "Hedgehog" Drinking Vessels from the 15th Cent. . . . 42
109. Drinking Vessel with "Stuck-On" Decorations. Second Half of the 16th Cent. . . . 43
110. Venetian Drinking Vessel with Diamond Engravings. About 1500 . . . 43
111. Venetian Glass: Drinking Vessel with a Lid and a Enamel-Painted Chalice. End of the 15th Cent. (PACM) . . . 44
112. Georg Kopidlanský's Drinking Vessel, Enamel-Painted, Venice, End of the 15th Cent. . . . 44
113. Milk-Glass Vessel. Enamel-Painted. Venice, End of the 15th Cent. (National Museum, Prague) . . . 44
114. Venetian Drinking Vessels with Fired-on Decorations. 16th—18th Cent. (PACM) . . . 45
115. Venetian "Wing" Glasses with Stippled Decorations. 16th Cent. (PACM) . . . 45
116. Venetian "Wing" Glass with Stippled Decorations. 16th Cent. (PACM) . . . 46
117. Vessel Blown in the Shape of a Ship. Venice. 16th Century (PACM). Photo: J. Brok, Prague . . . 46
118. Venetian Glass with Lid. Thread-Glass. 16th Cent. (PACM) . . . 47
119. Venetian Glass with Lid. Thread-Glass. 16th Cent. (PACM) . . . 47
120. Small Venetian Jug Made of Netted Thread-Glass. First Half of the 17th Cent. . . . 48
121. Magnificent Venetian Dish of Netted Thread-Glass (PACM) . . . 48
122. Two Spanish Beakers with Milk-Glass Edges. 18th Cent. (PACM) . . . 49
123. Spanish Glass Vessels with Elaborate Decorations. 16th to 18th Cent. (PACM) . . . 49
124. Two Spanish Vases, One Made of Green Glass with Handles and Attached Decorations in the Shape of Shells, 18th Cent.; the Other from Catalonia, Yellow with Melted-on Decorations (PACM) . . . 50
125. Green and Blue Spanish Vessels with Elaborate Fired-on Decorations (PACM) . . . 50
126. Persian (Iranian) Jugs with Fired-on Decorations of Coloured Glass (PACM) . . . 51
127. Catalan Vessel of White Glass with Fired-on Decorations. Catalan Dish with a Lid, Greenish Colour with White Threads, Worked in the Venetian Fashion. From the 17th Cent. (PACM) . . . 51
128. Small Jug of Thread-Glass, Spain, 1700 (PACM) . . . 52
129. Spanish Vessel for Oil and Vinegar. 18th Cent. (PACM) . . . 52
130. Yellow-Striped Catalan Flask with a Spout (PACM) . . . 53
131. Oil and Vinegar Bottle, Spain (PACM) . . . 53

132 and 134. The Maximilian Beaker, Diamond Engraving on Both Sides. Moravia, 1582. Castle Buchlov. (PACM) . . . 54
133. Diamond Engraving on a South Bohemian Drinking Vessel Depicting the Emperor and the Grand Electors. Apparently 1600. Castle Buchlov (PACM) . . . 54
135. Drinking Vessel with Diamond Engraving. Hall in the Tyrol. 16th Cent. (PACM) . . . 55
136. Glass with a Lid. Diamond Engraving (PACM) . . . 55
137. Dark Blue, Cylindrical-Shaped Bottle from Southern Germany, with Diamond Engraving. About 1672. Angel with the Symbol of the Millers . . . 55
138. Giacopo Versalini: English Glass with Diamond Engravings, Dated 1580 . . . 55
139. Two Coloured, Enamelled Glass Disks, One with the Coat-of-Arms of the Wartenbergs (Bohemia 1594), the Second with the Coat-of-Arms of the Kolovrat Family (Bohemia 1579). (PACM) . . . 56
140. Enamelled Beaker, Belonging to the Wanderer Family of Altmannsdorf, Württemberg (Pazaurek Collection in the PACM) . . . 56
141. Enamelled, Bohemian Renaissance Jug of Dark Blue Glass with the Motif of the Fable of the Fox and the Geese. 1595. (PACM) Photo: Illek—Paul . . . 56
142. Glass with Escutcheon, Enamel-Painted. Castle Buchlov (PACM) . . . 57
143. Glass Belonging to Albrecht von Wallenstein, with Enamel-Painted Escutcheon . . . 57
144. Glass Belonging to Vratislav of Pernštejn. Before 1582. Castle Buchlov (PACM) . . . 57
145. Glass with Enamel-Painted Escutcheon of the Family of Schönberg-Einsiedel. Bohemia 1585 (PACM) 58
146. Enamel - Painted Glass Ascribed to Christian Preussler. 1680. (PACM) . . . 58
147. Enamel - Painted "Elector" Beaker, Bohemia, 1593. (PACM) . . . 59
148. Enamel - Painted Drinking Vessel by Chr. Preussler, Representing a Silesian Glass-House. 1680 (PACM) 59
149.—150. Two Enamel-Painted Beakers from the Cluny Museum, France. Collection of Count Wilczek . . 60
151. The Coat-of-Arms of the Schürers of Waldheim on a "Madonna" Jug. Falkenau, North Bohemia, 1647 (PACM) . . . 61
152.—153. Example of Enamel-Painting on an Earthenware Jug, Wellner, 1628 (PACM) . . . 61
154. Enamelled Glass Jug, End of the 16th Cent. City Museum, Prague . . . 61
155. Beaker with Diamond Engraving, Painted by the Cold Method, Representing the Crucified. 1614, Germany (PACM) . . . 62
156. Decorations in White Enamel on a Beaker, Bohemia, 17th Cent. Castle Museum at Roudnice . . . 62
157. South Bohemian Beaker, Diamond Engraving, Oil Painting. 1621 (PACM) . . . 62
158. Oriental Jug Cut out of Rock-Crystal. St. Denis Treasury, France . . . 63
159. Burgundian Jug of Rock-Crystal. Facet Cut . . . 64
160. Small French Jug of Rock-Crystal. End of the 16th Cent. Set in Cold . . . 64
161. Double Goblet and Cup of Rock-Crystal . . . 65
162. Rock-Crystal Goblets . . . 65
163. Small Rock-Crystal Basket . . . 66
164. Small Jug of Rock-Crystal with Spouts on Both Sides . . . 66
165. Glass Plate Engraved by Kaspar Lehmann, 1606, Prague: Depicts the Saxon Elector Christian II. (PACM) . . . 67
166.—167. Kaspar Lehmann: Glass with Engraved Decorations According to an Engraving by J. Sadeler, 1597: Potestas and Liberalitas (with the Escutcheon of the Counts of Rogendorf and Losenstein), Bohemia, 1605. Castle Hluboká on the R. Vltava (now PACM). Photo: J. Brok, Prague . . . 68
168.—170. Three Engraved and Cut Nuremberg Goblets from the Second Half of the 17th Cent. (PACM) 69
171. Rock-Crystal Set. Prague, 17th Cent. (PACM) . . . 70
172. Engraved Glass with the Allegories of the Five Senses (Based on an Engraving by Martin de Vos). Bohemia, Middle 17th Cent. (PACM) . . . 71
173. Glass with Bas-Relief and Intaglio Decorations, Showing the Coat-of-Arms of the Alliance of the Magistrate of the County of Kladsko (now Kłodzko), M. V. Fr. of Althan and the Countess of Kokořov; Probably the Work of the Winter Workshop in Petersdorf (now Piotrowice) 1690—1698 . . . 71

174. Drinking Vessel with a Lid. Baroque Work, Cut-Glass with a Ruby Spiral in the Stem. Bohemia, First Half of 18th Century (PACM). Photo: J. Brok, Prague 72
175. Baroque Drinking Vessel, Cut-Glass with a Ruby Spiral Melted in. Bohemia, Beginning of 18th Century. (PACM). Photo: J. Brok, Prague 72
176. Baroque Drinking Vessel with Lid. Ruby Threads, Bohemia. First Half of 18th Century (PACM). Photo: J. Brok, Prague 72
177. Barock Vessel with Lid. Engraved, Bohemia, First Quarter of 18th Century (PACM). Photo: J. Brok, Prague 73
178. Baroque Goblet, with Engraved Leaf Ornaments and Birds, A Ruby Spiral is Melted into the Stem. Bohemia, Beg. of 18th Century (PACM). Photo: J. Brok, Prague 73
179. Baroque Vessel with Lid, Cut and Engraved, with a Ruby and Avanturin Spiral in the Stem. Bohemia, First Quarter of 18th Century (PACM). Photo: J. Brok, Prague 73
180. Baroque Vessel with Engraved Foliage and Thread Decorations, Festoons of Fruits etc. Bohemia, About 1720 (PACM). Photo: J. Brok, Prague 74
181. Baroque Vessel with Engraved Coat-of-Arms of the Abbot of Strahov (Prague) Marianus Hermann. Bohemia (PACM). Photo: J. Brok, Prague 74
182. Vessel with Lid with Engraved Thread and Foliage Decorations Bohemia. About 1730 (PACM). Photo: J. Brok, Prague 74
183. Engraved Baroque Vessel, Bohemia, Beg. of 18th Century (PACM). Photo: J. Brok, Prague . . . . . .
184. Decorated Venetian Vessel with a Rose Stem. Bohemia, End of 17th Cent. (PACM). Photo: J. Brok, 75 Prague 75
185. Vessel with Flacon Lid, Baroque Cut, with Coat-of-Arms. Bohemia, About 1735 (PACM). Photo: J. Brok, Prague 75
186. Cut, Bohemian Drinking-Cup, About 1700 (PACM) 76
187. Cut, Silesian Goblet in the Shape of the Horn of Plenty, with the Coat-of-Arms of the Schaffgotsch Family, Below a Lion. Hirschberg (now Jelenia Góra). End of 17th Cent. (PACM). Photo: ÚLUV — J. Otto 76
188. Beaker with a Bell-Shaped Stem, Engraved with the Coat-of-Arms of the Haintz-Schönau Family. Bohemia, 17th Cent. 76
189. Goblet with Deep Intaglio Decorations in the Rock-Crystal Manner. Silesia, Schaffgotsch Glass-House, About 1700. (PACM) 77
190. A Similar Goblet with the Coat-of-Arms of the Schaffgotsch Family. Silesia, Hirschberg Valley, End of 17th Cent. (PACM) 77
191. Silesian Bas-Relief Goblets from the End of 17th Cent. (PACM) 78
192. Silesian Cut-Glass Beaker, First Half of 18th Century. (PACM) 78
193. Bohemian Glass with Lid, Engraved (Shepherd Scenes). Middle of 18th Cent. (PACM) 78
194. Engraved Cut-Glass Goblet with the Portrait of Emperor Charles VI and the Coat-of-Arms of the Grand Electors. Bohemia, 1711. (PACM) 79
195. Engraved Cut-Glass Goblet with Stem in Shape of a Bear. The Engraving Represents Diana with Acteon, 1712. Germany. (PACM) 79
196. Engraved Cut-Glass Goblet with the Portrait of Emperor Leopold I. First Half of 18th Century. (PACM) 79
197. Richly Engraved Cut-Glass Goblet from Silesia. First Half of 18th Cent. (PACM) 80
198. Engraved Cut-Glass Goblet, Dance of the Beasts. Silesia. 18th Cent. (PACM) 80
199. Baroque Goblet, Cut-Glass, Richly Engraved. (PACM) 80
200. Detail of the Engraving on the Nuremberg Goblet "Cavalry Battle" H. W. Schmidt. 1690. (PACM) . . 81
201. Detail of the Baroque Engraving of a Coat-of-Arms and an Allegory on a Goblet 81
202. Engraved Cut-Glass Bohemian Beaker. 18th Cent. (PACM) 82
203. Ch. G. Schneider, Silesia: Engraved Cut-Glass Beaker. 1760. (PACM) 82
204. Engraved Goblets with Plastic Decorations, Silesia, First Half of 18th Cent. (PACM) 83
205. Engraved and Cut Vessels of Crystal-Glass. 18th Cent. (PACM) 83

206. Cut-Glass Flask with Chinese Decorations on a Dull Background. A. W. Mäuerl, Nuremberg. 17th Cent. (PACM) 84
207. Cut-Glass Flask with Flowers and Fruits. Dull Background 84
208. J. Schaper (?): Black-Enamelled Beaker from the Years 1660—1670. Germany (PACM) 85
209. Relief Cut and Engraving on Gold-Ruby Vessels, Set with Silver, All from the Years 1710 to 1720. (From R. Schmidt's Work) 86
210. Ignatz Preissler: Flacons and Jug with Black Painting; Hunting Motifs. Kunštát, About 1725—1730. (PACM) 87
211. Preissler: Dish, Decorated with Black Enamel and Gold-Inlaid Grotesques. Kunštát, About 1720. (PACM) 87
212. Preissler: Jug with Lid, Painted in Black and Gold. Bohemia, About 1725. (PACM) 88
213. Preissler: Goblet Painted in Black. About 1725. (PACM) 88
214. Preissler: Glass Carafe, Black-Gold Painting. Bohemia, About 1725. (PACM) 88
215. Preissler: Octagonal Painted Beaker with Black Chinese Decorations. Photo: ÚLUV 89
216. Preissler: Black Painted Glass. Castle Hluboká, Bohemia, About 1730. (PACM) Photo: ÚLUV 89
217.—218. Two Dutch, Diamond-Stippled Glasses. 1728. Goddess "Maas" and a Garden 90
219.—220. Two Green "Rummers", Diamond Engraving, with Fired-on Decorations of Raspberries. Second Half of 17th Cent. 91
221.—222. Venetian or Dutch Beakers with Relief Stems. 16th or 17th Cent. 92
223.—224. Two Green Dutch Glass Flasks, one with a Tin Lid with a Chain, with Diamond-engraved Inscriptions. Producer: Willem van Heemskrecht, Leyden, 1674 and 1684 93
225.—227. Three Old English Glasses (PACM). Photo: J. Brok, Prague 94
228. Swedish Wine Glass, Engraved. Monogram of King Charles XII. 95
229. Old Swedish Water Carafe, Engraved 95
230. Old Swedish Flask with Engraved Coat-of-Arms. 1705 95
231. Old Swedish Decanter, Engraved 95
232. Double-Walled Glass. The Space between the Walls is Coloured with Red Enamel. Gold Decorations. The Bottom is Decorated with an Equestrian Picture. Bohemia, 1730. Photo: ÚLUV 96
233. Double-Walled Glass with Transparent Enamel Painting. Picture of St. Ludmila. First Half of 18th Century. (PACM) Photo: ÚLUV 96
234.—235. Double-Walled Glasses, Bohemia, About 1740. On the Left the Prague Crusaders, on the Right the Madonna of Hejnice (Haindorf) (PACM) 96
236. Small Double-Walled Glass with Gilded Hunting Scenes (Bear Hunting). On the Bottom There is a Hare. Bohemia, 1730. (PACM) 96
237. Back View of Same. Photo: J. Otto, ÚLUV 96
238. Bohemian Double-Walled Glasses with Scenes from Feudal Life, Scratched into Gold Folio. About 1730 97
239. J. J. Mildner: Milk-Glass with Portrait of the Squire of Fürnberg 1788 98
240. Mildner: Milk-Glass, Madonna with Christ Child. About 1788 98
241. Mildner: Milk-Glass, A Fool with Two Women. 1789 98
242. Mildner: Picture of a Shepherdess. About 1788 98
243. G. S. Mohn: Semi-Transparent View of Dresden, 1816. (PACM) 99
244. G. S. Mohn: Semi-Transparent View of the St. Stephens' Cathedral in Vienna. About 1825. (PACM) 99
245.—246. Semi-Transparent, Painted Glass. To the Left the Yard at Strahov, to the Right the Castle Square in Prague. Painted: L. Hoffmeister and A. Kothgasser. Beginning of 19th Cent. City Museum Prague 99
247. Gottlob Mohn: Hunter on Horse-Back. 1818 100
248. Gottlob Mohn: View of Laxenburg. 1812 100
249.—250. Gottlob Mohn: The Kärntner Street in Vienna. 1814. — Painted and Cut Glass with a Cossack. 1817 100
251.—252. Ant. Kothgasser: Cut and Painted Glasses 101
253. Ant. Kothgasser: Glass with the Portrait of the Duke of Reichstadt. 1832 101

254. Ant. Kothgasser: Cut and Painted Glass, About 1835 . . . 101
255. Cut and Engraved Glass with Figural Decorations and Inscription. Glass-House Milovary, Middle of 19th Cent. Photo: ÚLUV — J. Otto . . . 102
256. St. Christophorus. Engraved by Master I. R., About 1810 . . . 102
257. Relief Glass with the Portraits of the Newly-Married Couple, the Vogels. North Bohemia. End of 18th Cent. (PACM) . . . 102
258. Cut and Engraved Empire Glass. Beginning of 19th Cent. (Private Collection) . . . 102
259. Cut and Engraved Glass, the Articles of Faith. Bohemia. Beginning of 19th Cent. (PACM) . . . 103
260. Allegory: Hope. Bohemia, Beginning of 19th Cent. (PACM) . . . 103
261.—262. Engraved Bohemian Glasses from the First Half of the 19th Cent. (PACM) . . . 103
263. Glass with Engraved Scene from Mozart's "The Magic Flute". North Bohemia, About 1820. (PACM). Photo: J. Brok, Prague . . . 104
264. Cut and Engraved Glass "Age". North Bohemia, 1830 . . . 104
265. Cut and Engraved Glass with the Portrait of Emperor Franz I. Bohemia, About 1806 . . . 105
266. North Bohemian Engraved and Cut Glass, About 1820 . . . 105
267. Castle Ambras in the Tyrol. About 1820. Engraved . . . 105
268. Anton Simm: Engraved and Cut Glass "The Seasons", Jablonec, About 1830 . . . 105
269. Vessel with Lid, Cut and Engraved, with the Inscription: Joseph Jungmann, Nový Svět, Signed "Pešina". 1832. Private Collection. Photo: J. Brok, Prague . . . 106
270. Bohemian Cut Carafe, Beginning of 19th Century. (PACM) Photo: J. Brok, Prague . . . 106
271. Glass Made of Ruby-Glass, Cut. Bohemia, About 1830. (PACM) Photo: J. Brok, Prague . . . 107
272. Glass Painted with Transparent Enamel. Bohemia, First Quarter of 19th Century. (PACM) Photo: J. Brok, Prague . . . 107
273. F. Egermann: Beaker with a Decoration in White Enamel, Relief. Blottendorf. First Quarter of 19th Century. (PACM) Photo: J. Brok, Prague . . . 107
274. Glass of White Opal, with Coloured Flower Painting. Bohemia, About 1840. (PACM) Photo: J. Brok, Prague . . . 107
275.—282. Dominicus Bíman: Portrait Sketches . . . 108
283.—284. Dominicus Bíman: Plaster Casts of Engraved Portraits of Ladies. First Third of 19th Century . . . 109
285.—286. Dominicus Bíman: Two Portraits of Ladies. About 1835 . . . 109
287.—288. Dominicus Bíman: Two Glass Disks with Portraits. (The First from the Year 1825 Represents Kaspar, Count of Sternberk) . . . 110
289.—290. Dominicus Bíman: Engraved and Cut Glasses with Portraits. About 1830 . . . 110
291.—294. Dominicus Bíman: Engraved and Cut Glasses. About 1830 . . . 111
295.—296. Hyalith Urns made at the Buquoy Glass-House. 1820. City Museum, Prague . . . 112
297. Hyalith Vase and Beaker. Bohemia, 19th Cent. (PACM) . . . 112
298. Fr. Egermann: Cut-Glass Flacons Made of Opaque Lithyalin. Beginning of 19th Cent. Nový Bor. (PACM) 113
299. Fr. Egermann: Glass of Opaque, Engraved Lithyalin. About 1830. City Museum, Prague . . . 114
300. Cut Lithyalin. About 1830. City Museum, Prague . . . 114
301. Fr. Egermann: Transparent Lithyalin-Glass, in Four Colours, Cut, Gilded. Nový Bor. From the Property Left by Egermann . . . 114
302. Fr. Egermann: Richly Gilded, Multi-Coloured, Semi-Transparent Lithyalin-Glass. Cut. (Left by Egermann) . . . 114
303. Fr. Egermann: Vase of Dull Bone-Glass with Black-Enamelled Still-Life. Beginning of 19th Century. Nový Bor . . . 115
304. Empire Goblet with Inscription: Le Coup de Vent. (Gush of Wind) 1810—1815. (PACM) Photo: ÚLUV, J. Otto . . . 116
305. Souvenir Cup, Second Half of 19th Cent. Bohemia. Engraver: A. K. Dux-Tempelbad. Photo: J. Otto 116
306. Fr. Egermann: Yellow Mordant on an Engraved Tea Glass, Dated 1820. The Oldest Known Yellow Mordant by Egermann. (Private Collection) . . . 116

307. Bas-Relief on an Escutcheon Glass. Bohemia. First Half of 19th Cent. (PACM) 116
308. Goblet and Glasses, Cut, Engraved, with a Colour Mordant. Bohemia, First Half of 19th Cent. (PACM) 117
309. Cut, Engraved Glasses with Ruby Decorations. Bohemia, First Half of 19th Cent. (PACM) 117
310. Cut, Engraved Glasses with a Colour Mordant. Bohemia, First Half of 19th Cent. (PACM) 118
311. Goblet and Glasses, Overlaid with Coloured, Transparent Glass, Cut, Engraved, Etched. First Half of 19th Cent. (PACM) 118
312. Glasses of Milk-Glass, with Enamel-Painted Decorations. Bohemia. End of 18th Cent. (PACM) 119
313. Milk-Glass with Enamel Painting. Bohemia, End of 18th Cent. (PACM) 120
314. Transparent, Violet-Coloured Glass with Engravings. Bohemia, About 1830 121
315. The Same, with Additional Cut Decorations. Same period 121
316. Dark Green Glass with Bone-Glass Layer Decorations. Bohemia, 1837 121
317. Bone-Glass with Light Green Opaque Glass Decorations, Cut. Bohemia, Middle of 19th Cent. 121
318. Lid Goblet of Cut-Glass, Etched with Red-Violet and Blue. Bohemia. Second Quarter of 19th Cent. (PACM) Photo ÚLUV — J. Otto 122
319. Magnificent Cut-Glass Goblet of Crystal-Glass. 19th Cent. 122
320. Cut-Glass Sugar Bowl. Harrachov Glass-Works 1818 123
321. Cut-Glass Vessel with Lid. First Half of 19th Cent. (PACM) 123
322. Cut-Glass Dish, Shell-Shaped. First Half of 19th Cent. ÚLUV — Photo: J. Otto 123
323. Goblet with Brilliant Cut. About 1840. (PACM) 124
324. Bohemian Cut-Glasses from the First Half of 19th Cent. 124
325. Sextagonal Folk Wedding Glass, Milk-Glass, Metal Stopper. Photo: ÚLUV; J. Otto 125
326. Four-Cornered Wedding Glass, with Engraved Decorations. Glass-House at Březina. Beginning of 19th Cent. Photo: ÚLUV - J. Otto 125
327. Three Folk Glasses with Painted Motifs. The One on the Right from the Year 1774. Photo: ÚLUV - J. Otto 126
328. Two Folk Jugs, Enamel Paint. Inscriptions. Dated 1816 and 1858. Photo: ÚLUV - J. Otto 126
329. Engraved Dish of Crystal-Glass. Designed by A. Eisenmenger. Edge by M. Knab. Made by F. Ullmann at the J. & L. Lobmeyr Works in Kamenický Šenov about 1880 127
330.—331. Small Jug of Crystal-Glass, Richly Decorated with Engravings. Executed by Herrman Müller in Mistrovice at about 1875. (PACM) Photo: J. Brok, Prague 128
332. Prof. Josef Drahoňovský: "The Bathe", Three-Coloured, Opaque Glass 129
333.—334. Prof. Josef Drahoňovský: Engraved Gems of Rock-Crystal. 1924 130
335. Prof. Josef Drahoňovský: Cut and Engraved Vase "On the Waves", 1912 (PACM) 131
336. Prof. Josef Drahoňovský: Engraved and Cut Goblet. 1923 131
337. Prof. Josef Drahoňovský: "Prague". Cut and Engraved Vase with Lid. 1935. (PACM). Photo: J. Brok, Prague 132
338. Prof. Josef Drahoňovský: St. Wenceslas Vase with Lid, Cut at about 1930. (PACM) Photo: J. Brok, Prague 132
339. Prof. Jaroslav Horejc: "Prague" Cut Vase of Crystal-Glass 133
340. Prof. J. Horejc: "The Three Graces" Cut Crystal-Glass Goblet. Executed by the National Enterprise "Artistic Glass", Lobmeyr, Kam. Šenov. Photo: J. Brok, Prague 133
341. F. Kysela: Relief-Cut Glass with Inscription "ČSR", Executed by the National Enterprise "Artistic Glass" Lobmeyr Works, Kam. Šenov. Photo: J. Brok, Prague 134
342. Prof. Jaroslav Horejc: "Canaan, The Land of Promise" N. E. "Artistic Glass", Lobmeyr Works, Kam. Šenov. 1923. (PACM) Photo: J. Brok, Prague 134
343. Prof. Karel Štipl: Cut and Engraved Crystal-Glass Vase for J. V. Stalin on his 70th Birthday.. Executed in the School of Arts and Crafts, Prague 135
344. Josef Soukup: "Theatre and Music". Cut Vase from the Year 1943. Carried out in Prof. K. Štipl's School. 135
345.—347. Zdenka Braunerová: Small Animals and Vessels, Blown, Painted Glass. 1925. Photo: ÚLUV, Prague 136

348. Master Emanuel Beránek Shaping the Scales of a Fish in his Glass-Workshop at Škrdlovice. Photo: Radimský, ÚLUV, Prague 137
349.—350. Prof. J. Brychta: Glass Figures and "The Pied Piper" State Technical School of Glass-Making, Železný Brod. 1926 138
351.—352. Milena Kytková-Roubíčková: Glass Paper-Weights. Photo: V. Rozegnal, Prague 138
353. Prof. Jaroslav Brychta: "The Shepherd". Executed in Glass by M. Klinger. Figures from the Film "The Glass-Suite". State Technical School of Glass-Making, Železný Brod. 1946 139
354. Prof. J. Brychta: "Glass-Figures". Made by M. Klinger. State Technical School of Glass-Making, Železný Brod. 1946. 139
355. M. Klinger: "Glass-Figures" Made of Transparent Coloured Glass. Produced by the Železnobrod Glass-Works. 1951. Photo: J. Brok, Prague 139
356. Ludvíka Smrčková: Vase, Executed by the Inwald Glass-Works at Teplice, 1948. Photo: J. Otto 140
357. Bohuslav Beránek: Fruit Dish of Clear Rosalin Glass with Decorations, Shaped by Hand. Škrdlovice, 1950. ÚLUV. Photo: J. Otto 140
358. Milena Velíšková: Ash-Tray in Shell Shape. Škrdlovice 1951. ÚLUV. Photo: J. Otto 141
359. Bohuslav Beránek: Ash-Tray. Topaz-Brown Colour. Škrdlovice. ÚLUV. Photo: J. Otto 141
360. Václav Trčka: Vase with Oblong, Coloured Hatching. 1950. ÚLUV. Photo: J. Otto 142
361. Prof. Josef Hospodka: Vase with Large Bubbles and a Layer of Ruby. Made by "Artistic Glass" N. E. Nový Bor 142
362. Prof. Josef Hospodka: Jardiniere. (Same Producers) 142
363. Vlasta Lichtágová: Vase. 1951. ÚLUV. Photo: J. Otto 142
364. Jan Kotík: Dish of Pure Crystal. Škrdlovice, 1953. Photo: J. Brok, Prague 143
365. Jitka Forejtová: Sugar Bowl and Honey Dish Made of Thin-Walled, Blown Glass. N. E. "Bor Glass" Vetter Works, 1953. Co-operation by V. S. ÚLUV. Photo: J. Otto 143
366. František Zemek: Jar of Thick-Walled Glass. Executed by the N. E. Železnobrod Glass-Works. 1951. Photo: J. Brok, Prague 144
367. Jan Kotík: Large Pot-Bellied Vase of Dark Topaz-Glass, Decorated with Merging Bubbles within the Glass. Executed by ÚLUV, Škrdlovice. 1951. Photo: J. Otto 144
368. J. Zahradníková-Brychtová: "The Father". Moulded Relief of Crystal-Glass. Železný Brod 144
369. Jaroslava Zahradníková-Brychtová: "The Hands of the Glass-Cutter". Moulded Relief of Crystal-Glass. Železný Brod 144
370. Oswald Haerdtel: Wine Service. N. E. "Artistic Glass", Lobmeyr Works, Kam. Šenov. Photo: J. Brok, Prague 145
371. Arch. Loos, Vienna: Service. Executed by the "Květen Glass Works" Moravia, for the N. E. "Artistic Glass", Lobmeyr Works, Kam. Šenov. Photo: J. Brok, Prague 145
372. Věra Lišková: Crystal Vase with Goblet. Karlovy Vary Glass-Works, N. E., Moser Works. Photo: J. Brok, Prague 146
373. Věra Lišková: Liqueur Service in Crystal-Glass. Karlovy Vary Glass, N. E. Moser Works. Photo: J. Brok, Prague 146
374. Věra Lišková: Vases and Ashtray of Crystal-Glass. "Artistic Glass". N. E. Lobmeyr Works, Kam. Šenov. Photo: J. Brok, Prague 147
375. Věra Lišková: Wine Service, Crystal-Glass. "Artistic Glass", N. E. Lobmeyr Works, Kam. Šenov. Photo: J. Brok, Prague 147
376. Erika Hellerová: Table Service. "Artistic Glass". N. E. Lobmeyr Works, Kam. Šenov. 1952. Photo: J. Brok, Prague. 148
377. Milena Korousová: Table Service. Executed by the "Květen Glass Works" N. E. 1951. Photo: J. Brok, Prague 148
378. Prof. Stanislav Libenský: Tea Service. "Artistic Glass" N. E., Nový Bor. Photo: Kramer, Prague 149
379. Pavel Hlava: Jar with Saucer with Cut Handle. Executed by the "Květen Glass Works", Moravia, 1953. (Co-operation V. S.) Photo: V. Rozegnal, Prague 149

380. Arch. Alois Metelák: Table Service. "Květen Glass Works", Moravia. 150
381. Adolf Matura: Jug and Drinking Glass with Polished Cut. Executed by the Karlovy Vary Glass Works N. E., Dvory Works, 1953. (Co-operation V. S.) Photo: V. Rozegnal, Prague 150
382. Jiřina Pastrnková: Cut-Glass Vase. Železný Brod. Photo: Honty, Prague 151
383. Prof. René Roubíček: Cut-Glass Vase. Crystal-Glass. State Technical School in Kam. Šenov. 1947. ÚLUV. Photo: Otto, Prague 151
384. Robert Boháček: Relief Cut Vase. 1949. Photo Rott 152
385. Prof. Stanislav Libenský: Cut Vase. 1953. Photo: J. Brok, Prague 152
386. Václav Plátek: Cut-Glass Vase. "Artistic Glass" N. E. Lobmeyr Works, Kam. Šenov. Photo: J. Brok, Prague 153
387. Věra Lišková: Vase of Coloured Glass, Decorated with an Edge-Cut. Karlovy Vary Glass, N. E. Moser Works. Photo: J. Brok, Prague 153
388. Václav Plátek: Vase of Cut-Glass. Železný Brod Glass, N. E., 1951. Photo: J. Brok, Prague 154
389. Milena Kytková-Roubíčková: Honey Jar. Cut Crystal-Glass. "Artistic Glass", N. E., 1952. Nový Bor. Photo: V. Rozegnal 154
390. Robert Boháček: Cut-Glass Dishes of Crystal-Glass. Photo: J. Brok, Prague 155
391. Václav Hanuš: Cut and Relief-Cut Jardinière. "Artistic Glass" N. E. Nový Bor. Photo: J. Brok, Prague 155
392. Věra Lišková: Cut-Glass Service. "Artistic Glass", N. E. Lobmeyr Works, Kam. Šenov. Photo: J. Brok, Prague 156
393. Ludvíka Smrčková: Cut Lead-Glass Dish. Photo: J. Brok, Prague 156
394. Miluše Kytková-Roubíčková: Cut, Decorative Vase of Lead-Glass, 1950. "Artistic Glass" N. E. Photo: J. Brok, Prague 157
395. M. Rathová-Backhausenová: Cut Jardinière. "Artistic Glass", N. E. Lobmeyr Works. Kam. Šenov. Photo: J. Otto 157
396. Miroslav Janků: Etched and Painted Vase. Photo: J. Brok, Prague 158
397. Miluše Kytková: Red-Glazed Vase. 1953. "Artistic Glass", N. E. Nový Bor. Photo: V. Rozegnal 158
398. Jiřina Pastrnková: Painted Dish. Železný Brod. Photo: J. Brok, Prague 158
399. Prof. Stanislav Libenský: "Pelicans". Etched Dish. Higher Arts and Crafts School for Glass-Making in Nový Bor 159
400. Miroslav Janků: Cut and Painted Beaker. 1949 159
401. Jiřina Pastrnková: Etched and Painted Dish. Železný Brod. Photo: Honty, Prague 159
402. Miroslav Janků: "Autumn". Etched and Painted Jardinière. Photo: J. Brok, Prague 160
403. Prof. Stanislav Libenský: "The Hussite Army". Etched and Transparent, Painted Vase. Executed by "Artistic Glass" N. E. Nový Bor. 1953. Photo: J. Brok, Prague 160
404. Jindřich Tockstein: "The Last Judgment". Železný Brod. 1943. Photo: J. Brok, Prague 161
405. J. Tockstein: "Don Quixote". Photo: J. Brok, Prague 161
406. Prof. Božetěch Medek: "Hay-making". Cut and Engraved Vase. Železný Brod. 1945. Photo: J. Brok, Prague 162
407. Prof. B. Medek: "Girl with a Basket of Grapes". Cut and Engraved Vase. Železný Brod. Photo: J. Brok, Prague 162
408. Václav Plátek: "Day and Night". Engraved Vase. "Artistic Glass", N. E. Lobmeyr Works, Kam. Šenov 163
409. V. Plátek: Diamond-Stippled Vase. (PACM) 163
410. Three Souvenir Goblet in Relief-Cut Crystal-Glass. The First Two by Maria Stáhlíková, the Third by Milena Korousová 163
411.—412. Prof. René Roubíček: "The Bathe". Engraving by Kurt Bischof. "Artistic Glass" N. E. Nový Bor. Photo: J. V. Maruška. Kam. Šenov 164
413. Arch. Metelák-Tockstein: Horse-riding on Beakers. Železný Brod. 1946. Photo: J. Brok, Prague 164
414. J. Straková: Engraved Souvenir Beaker. ÚLUV. Photo: J. Otto 165
415. Věra Lišková: Engraved Souvenir Beaker. Photo: T. Honty, Prague 165
416. Prof. Karel Hrodek: Engraved Jar With Monogram. Photo: J. Brok, Prague 166

418. Prof. K. Hrodek: Engraved Jars. Photo: Jaroschy 166
419. Věra Lišková: Beaker with Zódiac signs. Photo: J. Brok, Prague 167
420. V. Lišková: Detail of the Previous Engraving. Photo: J. Brok, Prague. 167
421. Ludvíka Smrčková: Cut-Glass Vase with Engraving. Karlovy Vary Glass, N. E. 1950. Photo: J. Brok, Prague 168
422. Jiřina Pastrnková: Cut and Engraved Vase. Železný Brod. Photo: J. Brok, Prague 168
423. Oldřich Žák: "Creation". 1930 168
424. Alois Hásek: Crystal Paper Weight, Engraved During his Apprenticeship with Prof. Drahoňovský. 1929. 169
425. L. Přenosil: Engraved Crystal Glass. Železný Brod. Photo: A. Dubský 169
426. Milan Metelák: Crystal Dish with Dull Drawing. Železný Brod. Photo: J. Hilger, Železný Brod 169
427. Erika Hellerová: Cut Drinking Glass with Intaglio-Engraving. "Butterflies". Engraved by J. Lauda, Cut by F. Kořista. "Artistic Glass", N. E. Lobmeyr Works, Kam. Šenov. Photo: J. V. Maruška, Kam. Šenov 170
428. Erika Hellerová: Cut Drinking Glass with Intaglio-Engraving "Castles and Forts", Engraved by J. May, Cut by F. Brabec. Photo: J. V. Maruška, Kam. Šenov 170
429. Erika Hellerová - Prof. J. Lipská (Straková): Cut Beaker with Intaglio-Engraving of the Portraits of Bavor Rodovský of Hustířan (1520—1600), J. S. Presl and a Motif of a Chemical Works. Portrait Engraving by E. Bischof, Factory Drawing and Inscription by R. Kolrus. Cut by F. Kořista, Portrait Design Prof. Lipská-Straková. Photo: J. V. Maruška, Kam. Šenov 171
430. Václav Plátek: Cut and Engraved Hexagonal Crystal Vase with the State Symbol of Czechoslovakia. Engraved by Miroslav Plátek. Železnobrod Glass, N. E. Photo: J. Brok, Prague 172

THE ILLUSTRATIONS HAVE BEEN TAKEN OVER FROM:

No. 1—8 J. Kunckel: Ars vitraria experimentalis.
No. 9, 94 to 102, 104, 105, 107 to 110 F. Rademacher: Die deutschen Gläser des Mittelalters.
No. 10 Abraham a Santa Clara.
No. 11—16 Verrerie en glace ou manufacture des glaces.
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No. 161—164 Qu. Leitner: Schatzkammer des österreichischen Kaiserhauses.
No. 209 R. Schmidt: Brandenburgische Gläser.
No. 217, 218, 238 R. Schmidt: Die Gläser der Sammlung Mühsam.
No. 228—231 H. Spitz: Aldre Svenska Glas Med Graverad Dekor.
No. 332. J. Čadík: Josef Drahoňovský.

ARTISTIC PHOTOGRAPHIES WERE TAKEN BY:

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Dubský: 425. Feyfar: 30. Glogar: 29. Hilger: 426. Honty: 382, 401, 415. Illek & Paul: 141. Jaroschy: 418. Kramer: 378. J. V. Maruška: 411, 412, 427—429. J. Otto: 187, 236, 237, 255, 304, 305, 318, 322, 325—328, 358—363, 367, 368, 369, 383, 395, 414. Radimský: 348. Rott: 384. V. Rozegnal: 351—353, 354, 379, 381, 389, 397. Vopat: 31.

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CONTENTS

Introduction 7

I. ANTIQUITY

ANTIQUITY LOOKS DOWN ON US FROM THE PYRAMIDS

Pallas Athene did not rise from the head of Zeus in a shining armour 13
The Eye of Pharaoh Amenhotep I. 13
A Glass Bead, 5 500 Years Old 15
The Egyptian Potter 15

THE OLDEST GLASS-HOUSES AND TECHNIQUES OF GLASS-MAKING

Ancient Glazes 17
The Tell-el-Amarna Furnace 17
Vessels of Glass-Fibres 18
Shapes and Colours 19
Glass Stones and the Oldest "Vasa Murrina" in Egypt 20
Climax and Decadence of the Vase Epoch 21

MOULDED GLASS — A PHOENICIAN PROBLEM

The Melquart Turquoise 23
Did the Phoenicians Invent the Blowpipe? 24

AND THE STONES BEGAN TO SPEAK

Glass in Assyria and Babylon 27
The Social and Economic Function of Glass 30

THE AGE OF ROME

A Picture of the Glass-house in Old Rome 31
The Treble Division of the Furnace 31
Furnaces According to Heraclius and Theophilus 32
A Late Roman Furnace in Britain 33

THE BLOWPIPE AND ITS OLDEST PRODUCTS

The Technique of Glass-Blowing 36
Tableware 37
Coloured Glass 37
The Composition of Glass 38
Mirrors 40
Jewelry 40
Ancient Glass-Houses 41
Ancient Glass-Engraving 42
Ancient Glass-Cutters 42
The Diatreton Vase 43

Cutting 44
A Few Preliminary Words About Painting and Gilding 44
The Shapes of Old Glasses 45
And the Lesson of All This 46

II. THE MIDDLE AGES

THE EARLY MIDDLE AGES HALVED THE WORLD

The Orient — the Refuge of Glass-Makers During the Great Flood 52
Byzantine Glass 53
The Medieval Orient and Glass-Making 54
The Composition of Oriental Glass and the Glass-Houses 56
The Glass-Makers 57
The Products 57
The Chinese Mould Stratified Hollow Glass 64
Russian Glass Production is Very Old 67
West European Glass Production in the Middle Ages 71
The Glass Window 74
Let Us Investigate Early Medieval Sources 75
Painted Windows 76
The Technique of Glass Painting 81
The Development of Window Painting After the Eleventh Century 82
The Changes in the Means of Production and the Glass Furnace 86
The Shapes of Hollow Glasses 89

WEST EUROPEAN GLASS-MAKING, ITS MEDIEVAL BEGINNINGS AND ITS DEVELOPMENT IN MODERN TIMES

Altare 90
France 91
Dutch, Flemish and Belgian Glass 92
Spain, Portugal, Mexico 92
Great Britain and the United States of America 93
Germany 96

III. THE SECRET OF VENETIAN GLASS-MAKING

Margherita — the Glass Bead 99
The Byzantine Glass-Makers Migrate to Murano 100
The Classification of Venetian Glass Production 102
Hollow Glass with Coloured Threads and Filigree Decorations 105
The Preparation of Rods for Spun-Glass 105
The Filigree Thread 106
The Complicated Technology of Filigree Designs 106
The Blowing of Filigree Glass 110
The Netting of Spun Glass 110
Millefiori — the Revived Egyptian Wonder, the Mosaic Flower Glass of Italian Provenance 111

IV. THE VICTORY OF BOHEMIAN GLASS

HOW BOHEMIAN GLASS-MAKING GAINED FAME

Rock-Crystal Leads Us Along the Right Track. Let Us Follow Its Overgrown Path 117
Now Something About the Raw Material and Its Treatment 121

THE "BOHEMIAN CRYSTAL" MAKES ITS FIRST APPEARANCE

Bohemian Church Windows 123
The First Glass-Houses 124
The Glass-Houses of the Sixteenth Century 124
The Old Technology 125
The Glass-Cutter and the Feudal Limitations 125
The Glass-Maker — Nobleman 126
Italian Glass-Makers in Bohemia 126
The Different Kinds of Products 126
The Income of the Glass-Houses 127
The "Bohemian Crystal" 127
The Price of Glass 127
Production Increased in the Sixteenth Century 128
Glass-Painting and Window-Glazing 128
"Glasses with White Stripes" 130
Refinement and the Increasing Export of Glass 130
And the Sources? 130
Kaspar Lehmann 131
The Rudolfinian Environment 134
The Victorious Bohemian Crystal 137

THE TWO HUNDRED YEAR RISE OF BOHEMIAN GLASS

Peaks and Crises 140
Apprentices 140
An Old Mirror Factory 142
The "Flux-Burners" 143
The Early Capitalists and their Proletariat 143
The Discovery of "Chalk-Glass" 144
A New Furnace and New Glass 145
Productivity 146
Wages 146
Beer 147
The Greedy Gilder 147
Coal Fires 147
A Glass-House Master Must 147
The Glass-House Farmsteads 148
A Bohemian Glass-House Abroad 149

Old Glass-Traders:

C. F. Kreybich 150
Johann Kaspar Kittel 150
Christian Franz Rautenstrauch 151
The Glass Trade Companies 152
Protection and Limitations 154
The Glass "Reglements" 155
The Significance of the Glass Export 156

V. AT HOME AND ABROAD

GREAT CHANGES IN THE WORLD DURING THE SEVENTEENTH TO THE NINETEENTH CENTURY

Johann Kunckel 161
Russian Glass Production in Modern Times 164
The Glass-Works at Gusj 165
The Oldest Glass-House in Slovakia 166
The Masters of New Glass Ornamentations 167
Dominicus Bíman — The Best Portrait Engraver 167
Friedrich Egermann 168
The Rest of the World 172
Sweden 173
Denmark 174
New Ideas in the Organization of Production 174
Man at the End of Feudalism 175

A Bohemian Glass-House During the Nineteenth Century:

Johann Rückel's Glass-House in Preitenštejn 176
The Turnov Stone-Cutters on "Soft Work" 181
Anton Paclt, Turnov Stone-Cutter 183
The Jablonec Industry 185
How Artistic Glass is Produced Today (With the expert co-operation of Ing. S. Bachtík) 186
Illustrations 195
Explanations I
List of Coloured Reproduktions IX
Illustrations to Text XI
List of Illustrations XVI
Bibliography XXVII
Contens XXXII

JAROSLAV R. VÁVRA

5000 YEARS OF GLASS-MAKING

The History of Glass

TRANSLATED BY I. R. GOTTHEINER, PH. D.
GRAPHIC ARRANGEMENT BY FRANTIŠEK MAŠEK

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